MARCH 1980

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March 1980

Vol. 30, No. 5
Issue 353

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We regret that we cannot answer technical queries over the telephone nor supply service sheets. We will endeavour to assist readers who have queries relating to articles published in *Television*, but we cannot offer advice on modifications to our published designs nor comment on alternative ways of using them. All correspondents expecting a reply should enclose a stamped addressed envelope.
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this month

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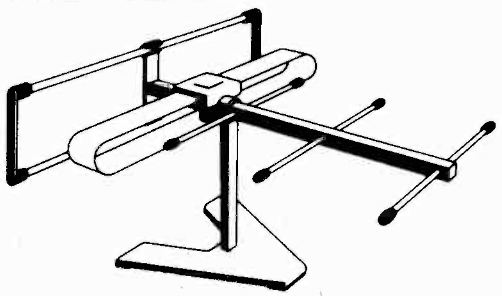

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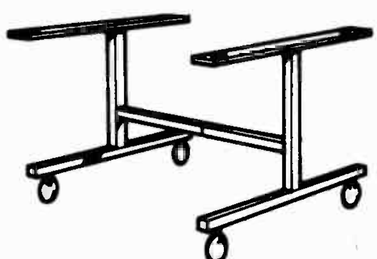

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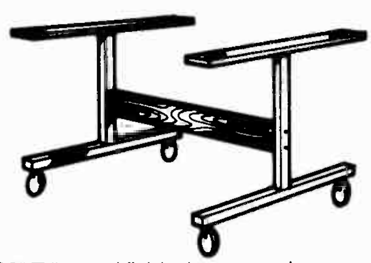

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TELEVISION

50 Years of Television

When it comes to technical developments, it's surprisingly difficult to pinpoint any particular date on which something first "happened". This is certainly true of television. There was a long gestation period when various things were being tried, demonstrations and test transmissions carried out, and so on. March 1930 (the 30th, to be precise) did not represent the start of a regular broadcast TV service, nor the start of TV transmissions as we know them today. Nevertheless the facts are that by March 1930 Baird television sets (Televisors as they were known) were on sale to the public, Baird had been given permission to use the BBC's Brookmans Park transmitters, from where on the 30th sound and vision signals were for the first time transmitted simultaneously, and had been given permission to transmit for half an hour a day, outside the normal radio broadcasting hours (the fee to be paid to the BBC was £5 per half hour!). One can say therefore that by March 1930 television broadcasting had made a start.

If you bought your Televisor (it cost £18), what did you see? Well for a start the system was a mechanical one, with 30 lines and a bandwidth of some 10kHz. The lines were scanned out vertically rather than horizontally, by means of a Nipkow disc. There were 12½ pictures per second, and the curious aspect ratio was 7:3. You received a picture of sorts, though with little detail and poor sync. The Televisor, which we show on our front cover, was in fact a remarkably simple device, consisting of a Nipkow disc, a motor to drive this and potentiometers to assist with synchronisation, a neon lamp to which the signal was applied (there was no amplification in the Televisor), and a magnifying lens. In fact it could well be described as a TV adaptor, since the signals, which were broadcast in the MW band, had to be picked up by and tapped from a radio receiver. The Televisors were produced for Baird by Plessey – about 1,000 of them, between 1929 and 1932.

Baird had been given a licence by the PO to instal two experimental 250W television transmitters as early as August 5th, 1926 (the fee for this was £6). It seems that only one of these (in Long Acre, London) was completed. It operated on 200m. By mid-1927, Baird had carried out informal experiments using a BBC transmitter (a stop was soon put to that). Baird's first formal demonstration to the PO, using his 250W transmitter (2TV), took place on September 18th, 1928, the BBC being given a separate demonstration on October 9th. The latter does not seem to have gone down too well, and was followed by a more elaborate demonstration on March 9th, 1929, when sound and vision signals were simultaneously broadcast (though not from the same transmitter). Baird gained official access to the use of BBC transmitters in 1929, with an inaugural broadcast (sequential vision and sound) on September 29th. Subsequently the provision of programmes was taken over by the BBC in August 1932, and the 30-line system came to an end on September 11th, 1935, by which time much higher definition systems had been developed (by Baird himself, EMI, and others in the USA, Germany and elsewhere).

From these modest beginnings, the development of television technology has been rapid, while TV services have spread to all corners of the globe. There are in fact few countries today without a TV service, and most are in colour. A TV service seems to be regarded as one of the prime essentials of life nowadays, on a par with electricity and mains water supplies. Satellite TV transmissions have in fact brought TV to areas lacking these other services (the Indian satellite TV service used portable power supply generators for reception in remote villages, giving rise to some sync problems with which Baird would have been familiar!).

It's amazing really to compare the Televisor on our front cover with the TX9 on last month's cover – and to reflect that the seeds of the latter come from the former. All in just 50 years.

Baird's subsequent 240-line mechanical system (with mirror-drum scanning) gave good pictures but lacked the flexibility of purely electronic TV. When the BBC's regular TV broadcast service started in 1936, there was a brief "systems war", since the EMI (electronic) and Baird (mechanical) systems were used alternately. The Baird system was dropped in February 1937, but ever since systems wars have been a feature of TV development. Battles have raged over which colour system to use, and more recently over various domestic TV recording techniques, both tape and disc. There are still plenty of videocassette systems in the fray, while the battle between the Philips/Sony optically-scanned and the RCA capacitive video disc systems has yet to start. It seems that many countries want to develop their own teletext systems, providing a fruitful field for future TV conflicts.

We've certainly come a very long way in TV during the past 50 years, and to mark the occasion the Science Museum is holding, from March to September, a special exhibition entitled "The Great Optical Illusion". It's admission free and open from 10.00-17.45 weekdays and 14.30-17.45 Sundays. For our part, Pat Hawker on a later page contributes an article on the pioneers of television.

FRONT COVER

Our thanks are due to Michael Hallett of the IBA for his help in enabling us to photograph the Baird Televisor at the IBA Gallery, 70, Brompton Road, London SW3 1EY. Mr. Hallet established and runs the gallery.

Teletopics

BBC DEVELOP DIGITAL STANDARDS CONVERTER

A new BBC designed digital field-store television standards converter has entered service at the Television Centre, where it's being used to convert between 525-line 60-field NTSC pictures and 625-line 50-field PAL pictures – in both directions. The new converter replaces the FS-series equipment which has been in service at the BBC Television Centre since 1968.

Digital field-store standards converters are not new of course. The IBA's DICE (Digital Intercontinental Conversion Equipment) has been in operational use for 525/625 conversion since early 1973 and for two-way conversion since the Spring of 1975. DICE uses a two-field store holding two complete fields of video information in digital form.

In designing their new converter, the BBC have taken advantage of developments in semiconductor technology to achieve improved performance compared with previous designs. In particular, the availability of dynamic MOS RAMs has made it possible to use cheaper, more compact field stores – the new equipment uses four stores, giving improved conversion performance. A further improvement in overall quality has been achieved by the use of comb filters to give optimum separation of the luminance and chrominance components of the signal prior to the conversion process.

The new equipment can also be used as a transcoder to change SECAM signals to PAL and vice versa, as a synchroniser for correcting the timing of one TV signal relative to another, or for cleaning up an input signal that's out of specification. Through the use of external decoders, the converter can be used with the entire range of internationally recognised TV systems, including 525-line PAL (PAL M). Should the incoming programme – news items from different sources for example – contain material in different standards, the converter automatically switches to the correct mode.

The design uses a microprocessor-based monitor unit to check the power supplies, temperatures and input/output conditions, with indication of any fault condition and the type of action required shown in plain language on a VDU screen. Digital test routines are also included to enable the equipment's operation to be checked when not in use for programme conversion.

The previous BBC FS-series converter used a single-field store with quartz delay lines employed as the storage medium. The new equipment arose from an analysis by the BBC's Research Department of the possibilities for a programme interchange system for the 1980s. The basic recommendation was that the converter should interpolate (produce its video output) from four incoming video fields in order to provide an output with virtually no visible impairment. The specification for the converter was drawn up in 1977, the first completed one being brought into operational use last July.

To convert from one field standard to another without noticeable impairment of picture quality, each output line must be synthesised from several lines of the input signal, a process called interpolation. Interpolation from lines within any one field is called spatial interpolation and interpolation using lines from different fields temporal interpolation. Since the converter stores four complete fields, temporal interpolation can be carried out across four fields (two complete pictures), giving a much closer approximation than previously obtained to the conversion characteristics required to give good portrayal of movement. In addition, the temporal and vertical interpolation processes are combined instead of being handled separately.

The interpolator in fact has simultaneous access to four consecutive lines in each of the four fields held in store – i.e., a total of sixteen lines is used in a single interpolation process in synthesising a line of signal at the output standard. The contribution a particular input line makes to the output line depends on its temporal and spatial positions relative to the output line, and is determined by an appropriate multiplication coefficient which is held in a programmable ROM. The process of interpolation consists of multiplying the sixteen input samples by sixteen coefficients and summing the resultant products. The colour and luminance signals are treated separately, and the use of optimum interpolation for each results in reduced video noise at the output compared with the input.

Any further developments in the operating characteristics of the converter can be taken into account simply by using a different PROM (programmable ROM) with the different interpolation characteristics required.

In converting from a 625-line, 50-field PAL signal to a 525-line, 60-field NTSC signal the input is sampled (to change from an analogue to a digital signal) at 15·94MHz: in the reverse direction the sampling is done at 15·73MHz (the different frequencies relate to the different subcarrier frequencies of the two systems). The eight-bit samples are stored with the luminance (Y) and colour-difference (UV) items interleaved in the five-word sequence YUYVY. Successive lines from each field are sequentially fed into each of the four stores, i.e. for a given field, store A holds lines 1, 5, 9 etc., store B lines 2, 6, 10 etc. and so on. The four kbit dynamic memory stores used are an industry standard device.

With conventional decoding, the luminance signal has an excessive residual colour subcarrier content, noticeable distortion due to inadequately filtered chrominance sidebands, and a severe dip in the luminance amplitude, attenuating fine picture detail. The use of comb filters in the PAL and NTSC decoders considerably reduces these effects, giving a substantial contribution to the converter's performance.

Congratulations are due to the BBC team, headed by John Astle, on achieving the most sophisticated and accurate conversion equipment so far devised. All light miles away from the Televisor on our front cover!

VIDEO DISC WAR

It seems that next year will see the start of the impending video disc war. As reported in this column last December, Sony and Philips have joined forces to develop the optically-scanned video disc. Meanwhile in the USA RCA reports that it is moving as rapidly as possible towards establishing production lines for mass production of the RCA Selectavision video disc system. The aim is to begin initial shipments for demonstration purposes in December this year, with nationwide (US) introduction of the system in the first quarter of 1981. The Selectavision disc is of the capacitance type, requiring a relatively simple player unit.

RCA has been working on the system for fifteen years, and is understood to have made a greater investment in the project even than in developing what became the NTSC colour system – which RCA pioneered in 1954 at a cost estimated at some $130m. RCA anticipates producing and selling some 200,000 players in the first year, with a 30-50 per cent penetration of US homes with colour TV in the first 10 years. A recent significant development is RCA's licensing of its long-term broadcasting and record industry rival CBS to manufacture and distribute Selectavision discs. The RCA-CBS link will ensure a wide range of material for the new system, a factor that could be a decisive advantage. The Selectavision disc player is expected to sell at around $500, with the discs at $15-20.

HOME SATELLITE TV RECEPTION

Interest in home satellite TV reception in the USA seems to be gaining momentum. The recent SPTS (Satellite Private Terminal Seminar) at Miami, Florida, organised by Bob Cooper, revealed an increasing amount of equipment for satellite reception, including a 10ft. fibreglass parabolic aerial selling at $520, and a "consumer orientated" receiver featuring remote control of volume and channel switching across channels 1-24, with automatic aerial rotation for selecting either vertically or horizontally polarised satellite transmissions, automatic selection of the 6·2 or 6·8MHz sound subcarriers, and an innovative threshold extension system that removes f.m. impulsive noise from signals as low as 8dB – all at a list price of $2,995 built and tested or $1,495 in kit form. Another interesting item was a complete receiver built into the aerial pick-up horn, with a cable to carry the signals indoors to a low-cost modulator: the suggested cost for this package (assembled) is around $1,800. The Miami SPTS combined three days of lecture sessions with an exhibition of TVRO (TeleVision Receive Only) equipment. Participants, who came from Australia, Europe, the Americas, Asia and several African countries, each received three complete manuals describing step by step construction of low-cost satellite TV receiving equipment and aerials. One demonstration consisted of reception from the USSR via a Molniya "inclined orbit" satellite positioned almost directly over Winnipeg.

AUTOMATIC COMPONENT INSERTION

Mullard have been expanding their range of bandoliered components for automatic component insertion. The range at present includes ceramic and film/foil capacitors, electrolytics, resistors, diodes and transistors. It's expected that by the end of the year at least half the everyday two-leaded electronic components used in Western Europe will be automatically inserted, the figure rising to 70 per cent by 1982 and 90 per cent by 1985. The days of laborious hand insertion of small components, with the errors that were inclined to occur, seem numbered.

PORTABLE WITH BUILT-IN GAMES UNIT

Pye have introduced a new version of their Rambler 12 monochrome portable with a built-in games unit. The games controls plug into a special socket at the side of the set, which is priced at about £5 above the standard version. Ten games are provided.

RCA'S LATEST COLOUR TUBE

RCA have released preliminary data and a type number for their latest 90° PIL colour tube – the A51-421X. The significance of this tube, with its associated yoke and neck components, is that neither NS nor EW pincushion distortion correction circuitry is required. It seems that before long the days of diode modulators and transductors for raster distortion correction will be behind us. The yoke is of the saddle-toroidal variety, giving high deflection sensitivity with low power consumption.

WARC RESULTS

The recent World Administrative Radio Conference, held in Geneva, has produced results which have been generally welcomed by UK broadcasting authorities. Of importance on the TV side are the extension of Band III by two 625-line channels (of value should the band be redeveloped for TV use after the closure of the 405-line service), the provision of up to four additional u.h.f. channels, and allocations for s.h.f. links to satellites, both for broadcast distribution and for outside broadcast use. Perhaps the most immediately significant point is the extra u.h.f. channels, since the broadcasting authorities have been experiencing increasing problems in allocating four channels to each of the vast number of relays required to provide extended coverage.

NEW IBA TEST PATTERN

The IBA has now started to use its new electronic test pattern (ETP1) in some ITV regions and has published a leaflet (available from Engineering Information Service, Crawley Court, Winchester) explaining the technical features of the pattern. The need for the electronically generated pattern arises from the IBA bringing into service four Regional Operations Centres which will replace the 14 IBA control centres (built to monitor and control the ITV u.h.f. network) over the next few years. An earlier form of the pattern was illustrated in Roger Bunney's *Long-Distance Television* column in our November 1978 issue.

VIDEO MARKET GROWTH

It's perhaps time to start thinking of the Japanese video rather than colour TV industry. Last year the Japanese sold £400m worth of VCRs, comparable with colour TV set sales – it's reported in fact that the world wide market for colour TV sets is shrinking. From exports of 139,000 VCRs in 1977, Japanese VCR exports rose last year to about 1·7 million (out of a total production of over 2·1 million). Philips have not been standing still either: from sales of 45,000 VCRs in 1975 the total rose to over 400,000 last year. Market researchers Mackintosh Publications Ltd. expect the European VCR market to increase from around 300,000 in 1978 to over 1·5 million in 1983.

EUROPEAN SATELLITE TV

Following the decision of the French and W. German governments to develop a joint satellite TV service for direct broadcasting to peoples' homes, Messerschmitt Bolkow Bloehm and AEG-Telefunken of W. Germany and Aerospatiale and Thomson-CSF of France have set up an industrial association to develop the necessary hardware. This looks like the start of a major European satellite TV industry – talks with the Chinese on the supply of a TV satellite are understood to have already started. The French side of the association hopes to earn some £1·9 billion from the operation by the end of the century.

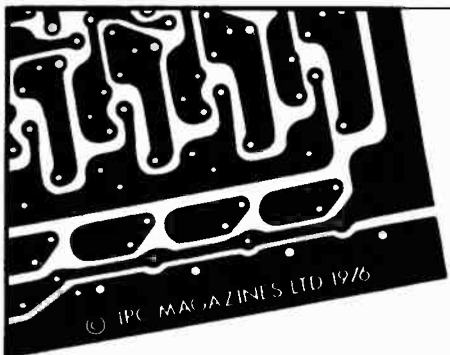
NEW TV CHASSIS

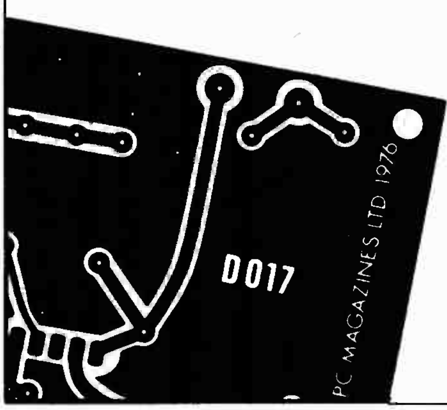
Details of several chassis recently introduced in the UK have come our way recently. First of these is the Rank T24E – the first outcome of the co-operation between Rank and Toshiba. It's a reasonably conventional design, with what we've come to regard as several typically Japanese touches. The RGB output transistors for example are mounted on the c.r.t. base panel, and also carry out the RGB matrixing (colour-difference signals to the bases, luminance to the emitters). There's a fairly long video channel, with five stages plus a transistor clamp. The colour decoding takes place in a single TA7193P i.c., with just one discrete transistor as chroma delay line driver – the luminance signal is kept out of the i.c., passing instead along the video channel just mentioned. A series regulator provides a 112V h.t. line for the transistor line output stage, which uses a diode-split line output transformer. Both timebase oscillators plus the sync separator are in a single TA7609P i.c. There appears to be plenty of i.f. gain, with a two-stage preamplifier on the tuner panel followed by a BF199 transistor driving a SAWF and then a TA7611AP vision i.f./a.g.c./a.f.c./video preamplifier i.c. on the main panel. The tube is the Toshiba SSI type. A transductor provides EW correction. Models include the Bush BC7200 and Murphy MC7240.

The K12 is the chassis used in the Pye/Philips "hi-fi TV" sets. This, as with other Philips continentally designed chassis, is highly modularised. The hi-fi sound (10W, with a two-speaker system and bass reflex enclosure) comes from a TDA2010Q i.c. A unique feature (so far as we know) is that the RGB drives are applied to the control grids of the 20AX tube. There's a linked switch-mode power supply/line timebase arrangement, with the chopper transistor doubling as line driver and the TDA2571/TDA2581 i.c. combination. Also an infra-red remote control system.

The Salora F series chassis uses a 110° PIL tube with a thyristor line output stage. Mains isolation is achieved by linking the power supply and flyback circuit to the rest of the chassis inductively. There's search tuning, with microcomputer control.

Sets using the Salora G series chassis are due for release in the UK later this year. This is basically a mains/battery portable design which will be used in 16, 20 and 22in. models. It's claimed to have the lowest power consumption of any colour set so far developed – a 40% reduction from the approximately 65W typical consumption of recent 20in. models to only 40W. The technique used to achieve this is described as an inductive transfer system between the power supply and the line timebase. At a guess, and we don't think we're all that far wrong, this would involve using the line output transformer as the inductive reservoir for the switch-mode power supply. ■





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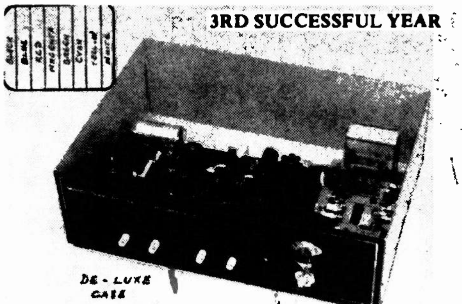

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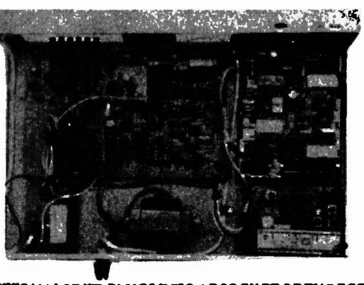

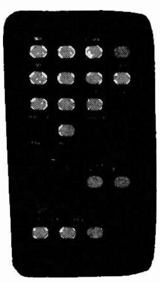

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PHILIPS 210 300 Series IF Panels **£2.90** p.p. £1.25.
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BUSH A823 (A807) Decoder Panel **£8.65** p.p. £1.25.
BUSH A823 IF PANEL (EXPORT VERSION) **£3.25** p.p. 95p.
BUSH Z718 BC6100 SERIES IF PANEL **£5.75** p.p. 80p.
BUSH A816 IF PANEL (SURPLUS) **£1.90** p.p. 80p.
BUSH 161 TIMEBASE PANEL A634 **£4.40** p.p. £1.25.
GEC 2010 SERIES TIMEBASE PANEL £1.15 p.p. 95p.
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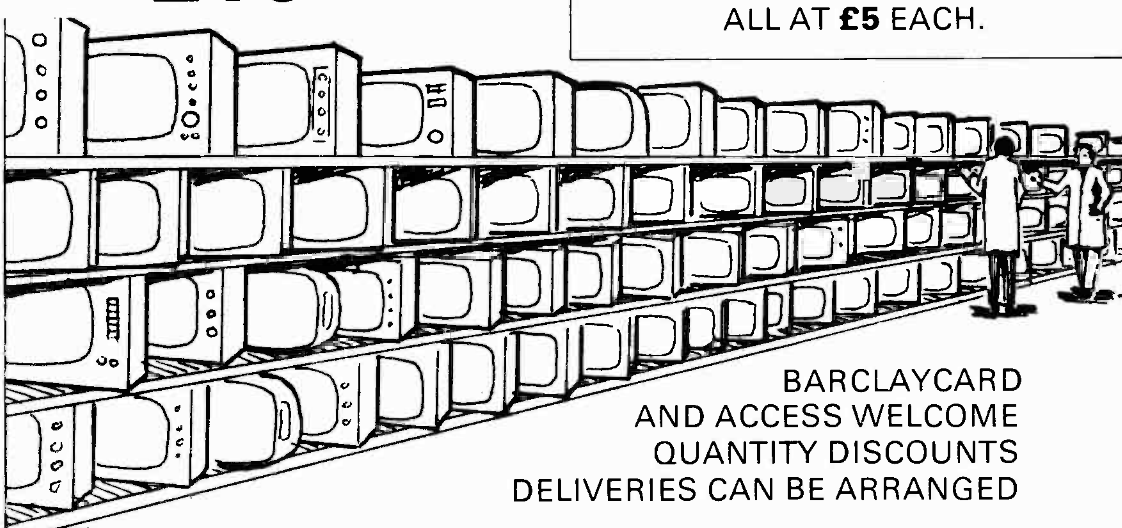

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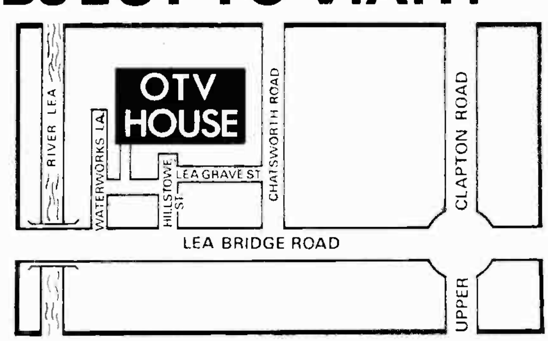

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Improved Sound Channel

Luke Theodossiou

THE colour receiver project we started in the October 1978 issue employed a single National Semiconductor LM1808 i.c as the intercarrier sound channel and audio amplifier. National Semiconductor have recently stopped production of this i.c., so an alternative approach has become necessary. The LM1808 has proved to be reliable enough in service, but there may well come a time when a replacement is required. Also, constructors who have embarked on the project in recent times have experienced difficulty in obtaining the LM1808. This situation can only get worse as the already limited stocks run out.

So an alternative solution which not only solves the supply problem but is also easy to incorporate on the existing board has been sought. We chose the SGS-Ates TDA1190Z i.c. since this is also used by at least one major setmaker (Decca) in their current chassis (70 series). This device performs all the functions that the LM1808 did, i.e. intercarrier sound amplifier, detector, d.c. volume control, a.f. amplifier and power output amplifier.

Fig. 1 shows a block diagram of the TDA1190Z plus the external components required. As can be seen, it's very similar to the LM1808. There are three main exceptions: the intercarrier sound amplifier requires an external *RC* network (C2, R2) which defines the gain; the power amplifier has its inverting input connected to pin 7 of the i.c., allowing the gain of the power amplifier to be externally determined (the LM1808 had a fixed power amplifier gain, minimising the external component count); and finally the TDA1190Z requires two additional capacitors (C9, C11) to ensure h.f. stability.

In order to make the mechanical arrangement as simple as possible, a daughter board has been designed to accommodate the new i.c. Most of the original components remain unaltered and in their present positions. Only the i.c. itself is removed, and R7 changed from 2·2Ω to 1Ω. The daughter board holds all the additional components required, and after assembly is simply hard wired into the holes originally occupied by the LM1808 in accordance with the circled reference numbers shown in the circuit diagram (Fig. 2). Fig. 3 shows the copper pattern for the new board and Fig. 4 the component layout. We suggest using 0·71mm (22 swg) tinned copper wire with insulating sleeves to make the necessary connections.

A bonus obtained from the use of the TDA1190Z is that it will deliver 4W of audio into a 16Ω speaker, almost double the output capability of the LM1808. Because of this feature, the i.c. requires a heatsink to cope with the extra dissipation. The recommended type is the Staver V8-800 (the same as used with the TDA1370 on the timebase board).

The volume control connections will have to be reversed, since with the TDA1190Z minimum resistance provides maximum volume. For those constructors who have incorporated remote control, the volume preset (VR3) is changed from 1k to 10k. It is useful to increase the value of C12 on interface board DO66 or C2 on board DO70 to 1000μF 25V. Since the volume control circuit is reversed, the + button on the remote control transmitter is used to *reduce* the volume, and the – button to increase it.

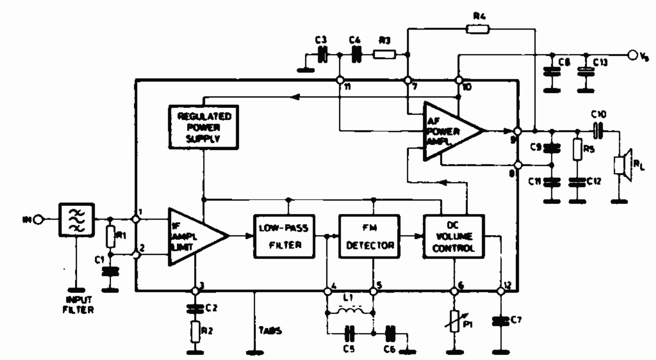


Fig. 1: Functional block diagram of the TDA1190Z with peripheral components.

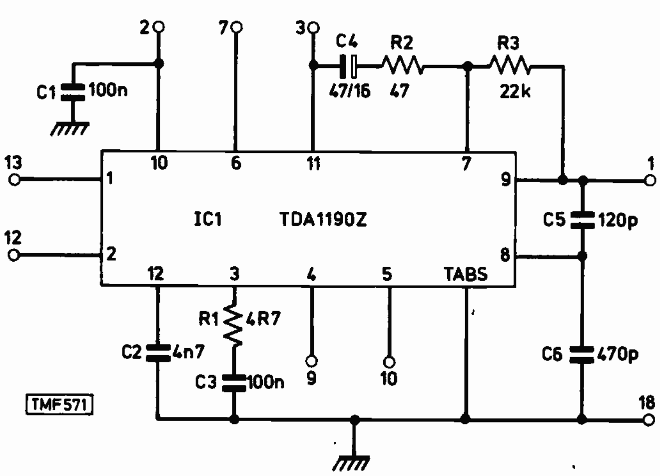
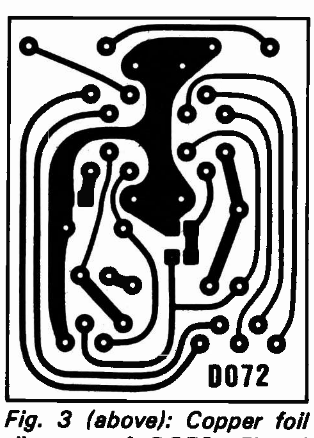


Fig. 2: Circuit diagram of the daughter board, showing the additional components required.



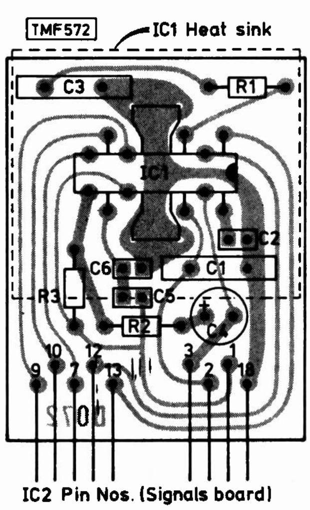


Fig. 3 (above): Copper foil diagram of DO72. Fig. 4 (right): shows the component locations.

Pioneers of TV

Pat Hawker

ONE thing needs to be said at the outset: nobody "invented" television. There was no one minute in history when anyone could accurately say for the very first time "Yes, I've got it". John Logie Baird genuinely felt he could claim this, but Baird was really the catalyst who stirred many others into taking television seriously. Television was conceived long before Baird, and depended on a whole chain of "little inventions" – a chain that continues to forged even today.

Early Ideas

Television, the ability to see at a distance, is a concept rooted firmly in the 19th century – originally a sort of electrical "philosphers' stone". Nowhere can this be seen more clearly than in the drawings of the Frenchman Alfred Robida in the 1890s: he foresaw in detail in his drawings television as entertainment, the large screen display, the video telephone, the video disc – and even some of the problems they would bring.

Robida (to whose work attention was drawn by Dr. Walter Bruch of PAL fame) did not bother about how his "Le Télé" machine would actually work, but there were plenty of others who were striving even then to realise real-time electric transmission of moving pictures. Indeed a public service for *still* pictures was inaugurated in France as early as the 1860s, between Marseilles and Paris – the result of the work of the Italian born Abbe Caselli. The sensitivity of selenium to light was discovered by the telegraph cable operator Lewis May in 1873. In 1880 a method of scanning a picture by means of a mirror was proposed by Maurice Leblanc; Paul Nipkow patented his scanning disc in 1884; and mirror-drum scanning came from Weiler in 1889.

Crude cathode-ray tubes (with cold cathodes) were also a 19th century development, by Ferdinand Braun, following on the work of Geissler, Gassiot, Goldstein (who in 1870 introduced the term "cathode rays") and Crookes. Braun called his 1897 invention a "cathode ray indicator tube", and explored the way in which the beam could be deflected to trace out Lissajous figures on a phosphor screen. Wehnelt warmed the cathode in 1905, and the "hard vacuum" tube was a later development.

Robida's conception of educational TV in the 1890s.

Over 70 years ago Boris Rosing in Russia and the Scottish engineer Alan Campbell Swinton (who has been called "the father of television") showed how these ideas could be brought together to form an effective electronic system of television. Contrary to popular belief, Campbell Swinton did not stop at describing the system but later attempted to build an experimental model. He failed to make it work, though some years later the EMI team repeated his experiment with success! His proposed pick-up tube included a mosaic of rubidium cubes, and his cathode-ray tube involved phosphor decay to aid the persistence of vision.

Baird's Mechanical System

"Baird arrived at Hastings in 1923 'coughing and choking' and generally in a bad state of health . . . he had little money, about £200, and after the disaster of the soap, socks and jam efforts his prospects were, to say the least, nebulous. Baird surveyed the situation and came to the conclusion 'I must invent something'" – according to Sydney Moseley, one of his many biographers.

He ignored the electronic ideas, and instead went back to the mechanical scanning of Nipkow – though with the tremendous advantage that by now the thermionic valve provided an efficient amplifier. He soon had a crude system he could demonstrate, though there are considerable doubts as to whether he ever achieved genuine synchronisation of his transmitter/receiver scanning discs in his early work. Ineffective synchronisation (as well as the low definition) was to remain a major problem with his 30-line system. The limit of 30 lines was imposed not by the mechanics of the system however but by the need to limit the bandwidth to what could be radiated on a medium-wave channel. Indeed Baird subsequently devised 60, 120 and 180-line systems, using the "flying-spot" mechanical camera.

Baird undoubtedly occupies an important, if curious, place in television history. P. P. Eckersley wrote of his "flair for picking about on the scrap-heap of unrelated discoveries and assembling the bits and pieces to make something work and so revealing possibilities, if not finality". Oddly enough perhaps his most original contribution to television, the Telechrome multigun colour picture tube, which formed part of his war-time work on all-electronic colour systems, is often overlooked. His early work and many "firsts" are described by Maurice Exwood in his 1976 IERE History of Technology booklet.

The 30-line system was a good training ground, but was never a practical home entertainment system. Baird worried and snapped at the BBC, plagued the Post Office, almost scared the daylights out of the politicians, and at times bamboozled the investors – if he had not done so the UK would certainly not have had a high-definition TV service on the air by 1936!

Electronic TV

Zworykin, von Ardenne, Karolus, Mihaly, Schroeter and many others were all key figures in the development of good television, though in the UK tremendous credit is rightly given to the joint work of EMI (the video side) and The Marconi Company (the v.h.f. transmitters) that led to the successful 405-line system. The team headed by Isaac Shoenberg at EMI included such brilliant research engineers and scientists as Alan Blumlein, Professor J. D. McGee, C. O. Browne, W. F. Tedman and many others.

J. D. McGee has pointed out that when leaving the Cavendish Laboratory to take up this post he was warned: "You had better take this offer, since jobs are scarce. I don't think this television business will ever come to much – but it will keep you going until we can get you a proper job" – an attitude which even after the success of their work was reflected by the editor of *The Guardian* newspaper writing: "Television. No good will come of this device. The word is half Greek and half Latin."

The EMI work (which was initially based on improving mechanical systems) began in about 1931. It was carried out under tight industrial security however and few details of the progress being made leaked out. Unlike Baird, EMI did not depend on publicity to attract funds.

Of great consequence was the development of the Emitron camera tube. This resembled Zworykin's iconoscope, which was patented in 1923 but not finally developed until the 1930s. Zworykin was working at RCA but despite the patent agreements between RCA and EMI the Emitron tube was designed independently. As early as 1932 recognisable pictures were obtained at Hayes, though the bad spurious effects present provoked C. O. Browne, who was working on the vision input equipment, to exclaim "What do you expect us to do with signals like those?"

In 1931 EMI ordered a v.h.f. transmitter from Marconi – Germany had already begun experiments at v.h.f., since engineers there were the first to realise that only by going to v.h.f. would there be sufficient bandwidth for high-definition pictures. This transmitter order led to the creation of the joint Marconi-EMI arrangement.

In 1934, with public recognition that the UK's 30-line system was by now falling well below the results being achieved experimentally on the Continent, an Advisory Committee under Lord Selsdon was set up to advise the

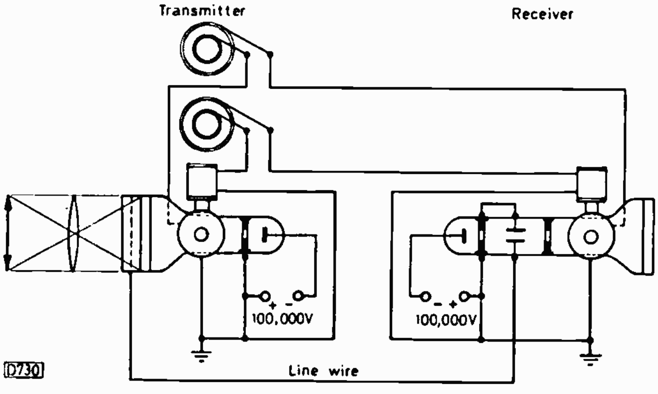
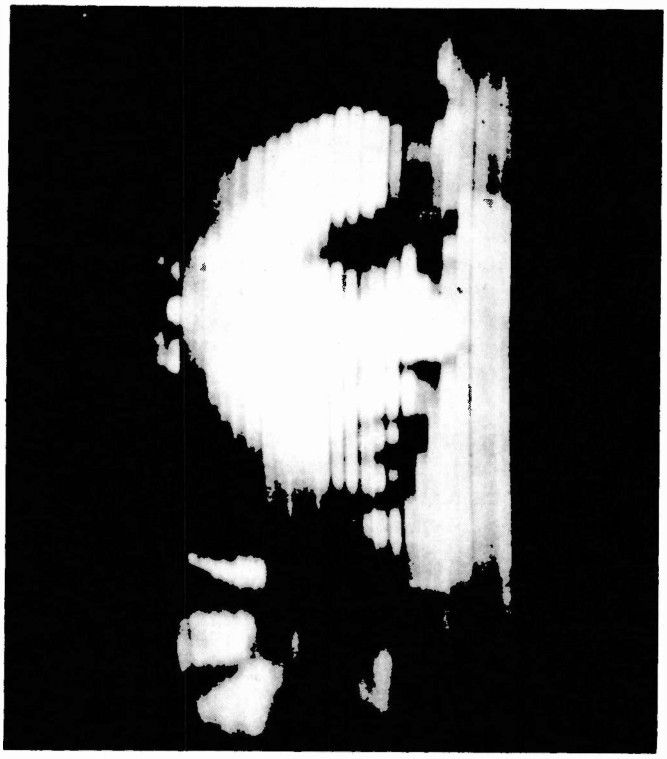


Fig. 1: A. A. Campbell Swinton's 1912 scheme for an electronic TV system. The main problem was that a camera "plate" to convert the picture into an electronic signal was not at the time available – the development of an effective camera tube was in fact the key to modern television.



Off-screen photograph – the 30-line picture produced by a Baird Televisor of the 1930-35 period.

government of the day. On January 31, 1935 a report was issued urging the early establishment of a public service with a definition "not inferior to 240 lines, 25 pictures a second" – a standard that had been demonstrated by the Baird Company (which by now included Captain West). No mention you will note of 405 lines.

In fact Blumlein had developed a system with 243 interlaced lines. This was a convenient number, using "divide-by-three" multivibrators to obtain the field frequency and then lock the chain to the mains-supply frequency – 243 comes down to 1 × 50Hz since 3 × 3 × 3 × 3 × 3 = 243 lines per field.

To steal a march on the rival Baird Company (or perhaps from curiosity), Blumlein decided he would like to try an even higher definition. The easiest way was to change one multivibrator to divide-by-five. Hence it was now 3 × 3 × 3 × 3 × 5 = 405 lines. Shoenberg courageously approved this higher figure, and "405" was written into the EMI specification – as a 50-field interlaced system.

Trial Period

In 1935 the BBC accepted both the Baird and Marconi-EMI proposals for a trial period, alternating weekly. This was despite considerable pressure to keep to a common 240/243-line system which would have met the Selsdon Committee's recommendations. One reason was that Scophony had developed a mechanical, large screen receiver, and it seemed unlikely that this could be stretched to 405 lines (this step was subsequently achieved however).

Limitations in both transmission and reception meant that there was precious little difference between the two sets of pictures actually seen in the home – indeed a 240-line sequential system can even today provide reasonable pictures. The downfall of the Baird system (it was discontinued in February 1937) was its lack of an electronic camera. It had been expected that the Farnsworth camera would have been available in time for the opening of the service (Farnsworth, in the USA, had developed a low-

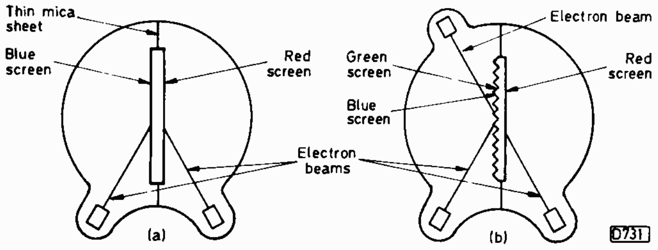


Fig. 2: The basic principles of Baird's Telechrome colour display tube, which he patented in 1940 and demonstrated to the press in 1941. (a) Arrangement of the phosphor coatings for a two-colour version. (b) Use of a riged back to the screen to provide two surfaces for a three-colour system.

definition electronic camera as early as 1927). Instead, the Baird system used an intermediate film system for "live" broadcasts – the film was processed in less than a minute.

Electronic cameras have in fact been the key to modern television. The principles of a pick-up tube akin to the iconoscope had been outlined in some detail by Campbell Swinton as early as 1911. Zworykin obtained his patent in 1923, but it was not until about 1932 that he had a demonstrable model. Farnsworth had a low-definition image dissector in 1927, and McGee and his colleagues were making good progress with the Emitron in 1932-33. The superior image iconoscope (Super-Emitron), also the orthicon (CPS Emitron), stemmed from Lubszynski, Rodda and Tedham at EMI. The image orthicon (1946) and the photoconductive vidicon tube (1950) came from RCA, and black-and-white TV reached a peak with the 4½in. image orthicon tube (which was proposed by RCA in 1952 but first put into production by EEV at Chelmsford in 1954). The 4½in. image orthicon provides brlliantly crisp pictures. A decade of difficult research by E. F. DeHaan and his colleagues at Philips resulted in the Plumbicon (lead-oxide) photoconductive tube becoming available in the mid-sixties – in time to become the work horse of colour TV.

Pre-war TV

Radiolympia from August 26, 1936 provided the public with its first chance to see the new systems. Some 100,000 people filed past a display of new receivers which officially remained anonymous but actually came from Baird, Cossor, Edison, Ferranti, GEC, Marconi-EMI and Philips. All were 12in. models, priced 85-105 guineas. Cossor, with a research team that included L. H. Bedford and O. S. Puckle, had originally developed a "velocity-modulated" electronic system, but this was never put into service.

While the official opening, some three months later on November 2, is generally considered to be the start of the world's first regular public high-definition service, it should not be forgotten that some 150,000 viewers at 28 public television rooms in Berlin had been able to see TV pictures from the 1936 Berlin Olympics (August 1-14). Three cameras (one manned by Walter Bruch) had been used with two specially-equipped mobile units. Germany had opened a 180-line service in March 1935, but in August the equipment was destroyed in a fire at the Berlin Radio Exhibition. Is 180 lines "high-definition" or "low-definition"? The British claim for Ally Pally priority depends on your answer!

Sales of receivers were extremely slow. For the price of a small motor car, viewers were at first limited to an hour of programmes in the afternoon and one hour in the evening. To get prices down, even 5in. models were made. From 300 sets in 1936, the total increased only slowly to about 20,000 by September 1, 1939 when the service suddenly closed down (finishing with a Disney cartoon film) for the duration of the war. (The sound transmitter was used for a time for "bending" German navigational beams.)

The pre-war receivers used valve circuitry that, even today, most service engineers would have no difficulty in recognising – exceptions were the common use of gas-filled triodes as timebase oscillators and the absence of flyback e.h.t. systems (lethal transformer e.h.t. supplies providing about 4kV were a decided hazard). Flyback e.h.t. had in fact by then been developed, by Blumlein, but was not taken up by setmakers until later. Philips however had developed their projection tube, with its 25kV unit, in the pre-war period.

War-time Developments

In 1939 virtually all TV research in the UK was switched into radar (RDF, or radiolocation, to use the original names). This was not the case elsewhere. A regular 525-line service was started in the USA in 1941, following the proposal of a 441-line system in 1936 and the demonstration of a 343-line RCA system at the 1939 World Fair. In Switzerland, the first form of Eidophor large-screen display was a wartime development.

The 1930s were full of "TV is here" and "TV just around the corner" stories. 30-line, low-definition TV was never good enough for real entertainment, competing as it did with the excellent picture quality of even the cheapest "flea-pit" cinemas. In the USA high-definition TV was slow in coming because of the classic "egg and chicken" difficulty of finding financial backers until there is a proven audience – or an audience until there are sufficient programmes. The UK, Germany and France have broadcast licence revenue, but the number of people willing or able to pay around £100 (in 1936 values) for a receiver was pitifully small. Much early effort in fact was directed at cinema television with large screens: the domestic home receiver market in the UK remained relatively small compared with sound radio until after the coming of ITV in 1955.

The Germans had a TV service in Berlin until November 1943, when the transmitter was destroyed by bombing. They also ran, for the Wehrmacht occupation troops, a TV service from the Eiffel Tower. This continued until August 16, 1944 (the pictures were monitored by British Intelligence in Kent).

Post-war TV

VE and VJ days came in the following year – and with them a major effort was made to get BBC TV back on the air. In the rush however a serious error of judgment was made. EMI urged that a new 605-line system should be adopted, to take advantage of the improved equipment that could by now be contemplated. Only a few thousand receivers would be made redundant. The Hankey Committee however turned this down in favour of 405 lines for the home, a 1000-line system being recommended for large-screen cinema presentation (which was still believed to be the only way in which millions of people could afford to watch TV). This resulted in all the later problems of switching from 405 to 625 lines. Europe might have standardized on 605 lines, instead of the 625-line standard suggested later by Walter Bruch!

The pioneers of colour deserve an article to themselves. Baird tried it with low-definition in the 1920s, then much more seriously in the 1940s when he proposed a multi-gun picture tube. CBS developed a sequential, non-compatible system to the stage where it was put into service (1951), but this required a bandwidth of some 12MHz and lasted only five months ("Goldmark's whirling dervish"). RCA came up with proposals for a compatible system, and in 1949 started a crash programme to develop a practical display device: Goldsmith, Schroeder and Law did so in a remarkably short time (the shadowmask tube), though the industry was at first convinced that it could never be mass-produced. The National Television Systems Committee in 1953 proved that sometimes a committee can design a thoroughbred horse. The early problems of NTSC colour led to work in Europe on producing systems less susceptible to transmission errors – though all drew on the ideas of NTSC. Bruch is always the first to admit that PAL was the offspring of NTSC and SECAM.

By now the pioneering days were over, though it took many years to build up the networks to cover the entire country, first in Band I and then, with the coming of ITV in 1955, in Band III. No longer could the UK claim to be the centre of the TV world (by 1954 there were over 30 million TV sets in the USA). The three major post-war developments – compatible colour with the shadowmask tube, videotape recording, and trans-ocean geostationary satellite relays – took place in the USA – coming largely from RCA, Ampex and Hughes Aircraft. Philips in Holland contributed the Plumbicon tube that so decisively improved colour transmission, while Henri de France developed the use of delay lines. All these incidentally were the result of intensive, large-scale industrial research efforts, working to a specific target.

This is not to decry the British effort. Thorn produced the world's first all solid-state (except for the picture tube) colour receiver. The IBA were the first with an operational digital video equipment (a line standards converter that preceded the 1972 DICE intercontinental converter), and indeed digital TV systems remain the prime area of development. It's not always recognised that ENG/EFP (electronic news gathering and field production) were made feasible by the digital line timebase corrector (again an American development). More recently the UK has contributed teletext and viewdata and much work on multi-channel u.h.f. transmission.

Pioneers in Many Fields

Looking back through this all too brief account of the development of television, one is aware of the many names that have not been mentioned because their work was not originally aimed at TV. The Japanese scientist Yagi for example, who has his memorial on millions of rooftops; Southworth of Bell Telephones whose work led to the coaxial cable; Rosen and Williams of Hughes for the geostationary satellite (whose concept came from Arthur Clarke's imaginative 1945 article in *Wireless World*); the work done on high-power valves and later power klystrons, much of it stemming from radar. And of course David Sarnoff and George Brown of RCA, who put the full resources of the company behind the development of compatible colour – and kept it going during the early, difficult days of 1954-60.

But in the end four names stand out: Alan A. Campbell Swinton, John Logie Baird, V. K. Zworykin and Alan Blumlein – even though, as we've seen, television was not born of a single flash of genius but was painstakingly developed by industrial research teams. The word television, so the Oxford English Dictionary tells us, entered our language in 1909. Yet in the 1890s the artist Robida was already plucking from his fertile imagination such terms as "Telephonoscopique", "Photo-phonographe" and even "Le Télé" (pronounced telly)!■

TV Servicing: Beginners Start Here . . .

Part 30

S. Simon

HAVING in the past three issues daintily dodged through the subject of colour decoders, which in practice don't give all that much trouble, we'll return to the more run of the mill faults which you'll certainly meet and perhaps wish you hadn't.

Servicing an apparently dead set can be most confusing if you don't know what type of power supply it uses. We're talking now about solid-state chassis, which may employ a thyristor to provide a regulated h.t. supply, or a switch-mode power supply or some other arrangement, and may employ various types of overload protection. First of all however let's back track a bit and remember how to deal with an apparently lifeless set using a simple power pack – i.e. the hybrid monochrome and colour sets that are still around in large quantities.

How delightfully simple it is with such sets to find out where the juice is, and where it isn't though it should be. You're immediately at the seat of the trouble, be it a blown mains fuse (due to a shorted mains filter capacitor or rectifier diode) or an open-circuit mains dropper/surge limiting resistor. The humble neon screwdriver will show you whether the mains supply is present at the fuse or the on/off switch, and as you delve a little deeper will bring to light the open-circuit which is removing the supply from the rest of the set.

The neon screwdriver will tell one a little with a solid-state chassis, but the approach required to the dead set fault is rather different. To illustrate the different fault tracing techniques, let's consider two common chassis from the Thorn stable. We'll discuss the hybrid monochrome 1500 chassis with its conventional power supply briefly, then go on to the 3000/3500 solid-state colour chassis which employs a switch-mode power supply (something we've not mentioned before in these articles).

Dealing with a Dead 1500 Chassis

You should by now feel confident enough about tackling the 1500 chassis. It does no harm to go briefly over some familiar ground however before taking a plunge into the unknown. Let's assume that you are confronted with a Ferguson Model 3820, or the equivalent HMV, Marconiphone, Ultra or what have you set (some Alba sets for example incorporate the 1500 chassis). You've got your multimeter and neon screwdriver handy, and the set is apparently dead. To be safe, you assume that it isn't. You start at the mains plug (if fitted) and ensure that this is properly wired and fused. If the brown lead is connected to the live terminal, the receiver's chassis should not be live when checked with the neon. If it is, either the mains socket is wired incorrectly, the blue wire is not contacting mains neutral, or the neutral side of the on/off switch is not making, thus leaving the rest of the set floating at the live mains voltage. Having ensured that the chassis is not live we can proceed, though with the following proviso: there are sets that have a live chassis whichever way the mains leads are connected, due to the use of a bridge rectifier in the mains input circuit.

Since the set we're considering is a Thorn 1500 we can rest assured that the chassis should not be live, and once this has been established we can check on the parts that should be live. There should be juice at the on/off switch and at the top centre 1·6A mains fuse. It's quite on the cards that if the plug fuse has been found blown the 1·6A fuse will also be found blackened, indicating a direct or almost direct short across the mains supply. This should direct suspicion to the mains filter capacitor (C84) to the right of the fuse or to the h.t. rectifier diode (W8) above it. Both can be easily checked with the meter on the low ohms range.

Whilst replacing a short-circuit filter capacitor and the fuse(s) will restore normal working if the capacitor is the culprit, replacing the diode may not have the same effect since the excess current that blew the fuse(s) will have passed through the associated surge limiting resistor R116 (20Ω) and the reservoir electrolytic C88. Since the surge limiter resistor leads a hard life at the best of times, it's all too likely to have gone open-circuit when subjected to this extra strain. Our neon tester will reveal this state of affairs by lighting up at one end of the 20Ω section of the combined wirewound resistor assembly ("mains dropper") but not at the other.

The dead set symptom may be due to another condition however. It's extremely common to find the fuse intact and h.t. present but the valves not lighting up due to the R111 (148Ω) section of the mains dropper being open-circuit. The neon will again verify this point.

Thus with a hybrid chassis using a simple power supply a dead set will quickly come to life after putting right a minor defect or two, though it isn't always like that. Let's move on now to the Thorn 3000 chassis.

Solid-state Receivers

When we took a brief look at the power supply circuitry used in hybrid colour sets we found it little different from that used in hybrid monochrome receivers. So the fault tracing drill is much the same. Why should things be so different with solid-state sets?

In all sets it's desirable to stabilise the e.h.t. voltage, so that the picture size doesn't vary with e.h.t. current variations. In colour sets it's essential to stabilise the e.h.t. voltage, otherwise the convergence and focusing as well as the picture size will vary. With a hybrid receiver a degree of stabilisation can be simply achieved by adjusting the bias applied to the control grid of the line output valve: pulses from the line output transformer are fed back and rectified by a VDR to produce the control action. We saw how this is done back in Part 4. With a line output transistor however this technique cannot be adopted – since the transistor is operated without base bias. So we have to do something else, and what we do is to stabilise the h.t. voltage instead. Since the e.h.t. voltage is proportional to the h.t. voltage, this gives us the regulation required. There are a few other technical aspects of e.h.t. stabilisation, but it's not the purpose of these articles to delve too deeply into receiver design.

Stabilising the HT Supply

We can stabilise the h.t. voltage in several ways. A series regulator transistor can be used, and this is the technique employed in mains/battery portables and many small screen colour receivers. We covered this in Part 16, where we also covered the use of a thyristor to provide a stabilised h.t. supply, a technique used for example in the Philips G8 chassis, the Rank A823 chassis and the GEC C2110 series. In our Thorn 3000/3500 chassis another technique is used – a switch-mode power supply. The circuit is shown in Fig. 1, and as you can see is rather more complicated than anything we've come across before. The control element is the chopper transistor VT604. It performs a similar function to a series regulator transistor, being in series with the set's h.t. supply. The mains supply is rectified by W602 which produces 300V across its reservoir capacitor C606. At the emitter of the chopper transistor a stabilised voltage of something between 58-65V, depending on the setting of R629, is obtained. Note that R629 is labelled "set e.h.t.", which brings home the point about e.h.t. regulation via the h.t. supply.

Use of a Chopper Transistor

The difference between a chopper transistor and a series regulator transistor is that the chopper transistor is switched on and off. The advantage is that this is a much more efficient system. The series regulator transistor is conductive the whole time the set is in operation, thus producing a continuous dissipation, i.e. energy loss. A chopper transistor is switched on and off by its drive circuitry, so that it spends a fair proportion of its time switched off. You save energy and reduce the amount of heat produced – and heat is something we want to reduce as much as possible in a TV set in order to increase reliability.

The frequency at which the chopper is switched on and off is not important. It's convenient however to carry out the switching at line frequency, and this is the case with the Thorn 3000/3500 series. Regulation is achieved simply by varying the on time of the chopper transistor. VT608 samples the output voltage from the chopper, and provides feedback to the chopper drive circuit to produce the required alteration to the on/off drive waveform applied to the chopper. A couple of further points before we get down to fault finding. First, instead of a capacitive reservoir, the chopper feeds an inductive reservoir (L603). The flow of current in the receiver must be maintained when the chopper switches off, and to this end W616 conducts when VT604 switches off and vice versa. So current flows continuously through L603, VT604 topping up the energy supply as it were when it switches on. C619 is the h.t. supply smoothing electrolytic.

Tackling the Thorn 3000/3500 Chassis

Sets fitted with the 3000 and 3500 (larger tube size) chassis are pretty thick on the ground at present and are likely to be on the servicing scene for a long time yet. They, and some other earlier solid-state colour chassis such as the Philips G8 and the Rank A823, are a little kind to us in one respect. The tube heaters are fed from a mains transformer rather than, as in later designs, a winding on the line output transformer. Thus a quick glance at the neck of the tube tells you whether or not the mains transformer is active. If the tube heaters are glowing, we know that the mains is applied and therefore the supply fuse and/or thermal cut-out is in order.

When the Cut-out Cuts Out

The red button thermal trip (cut-out) on the rear upper left side of the Thorn 3000/3500 chassis is a prime suspect when the set is dead and the tube's heaters are not glowing. After it has popped out and been pressed back in again several times it gets a little weary (or pitted) and is reluctant to make reliable contact. So this is where we start, and little expertise is required here. The cut-out has two tags at the rear. So if the neon lights on one but not the other the cut-out is open-circuit, due either to a fault in itself or to an overload in the set.

The cut-out must not be defeated by pressing it in and holding it in – no attempt should be made to do this. If it simply pops out as soon as it's pressed in, it can fairly be suspected. If on the other hand it holds for a moment and there's a hum from the set before it pops out, there's a fault in the set. Under no circumstances should the device be shorted out, unless by means of a fuse of some 2·5A rating. The use of heavy fuse wire or any other means of bridging the contacts can result in severe damage and the probable loss of some expensive item such as the mains transformer. The power unit in these sets is that swing up panel on the top left (viewed from rear).

At the rear of this unit is a large wirewound dropper with several sections. At the front of the panel itself are four diodes in a row. It's extremely common for one of these diodes to go short-circuit, and the resultant heavy current must pass through the mains transformer (T601). It's a matter of moments to check these diodes with the ohmmeter on the lowest ohms range. A reading of less than 20Ω should give cause for concern, which will be justified if reversing the prods gives the same reading. Two of the diodes (W601 and W602, BY127 or equivalent) are for the h.t. supplies (there's also an unregulated 240V rail which supplies the RGB output stages) and two (W603 and W604, BY126 or similar) are for the 12V and 30V supplies.

As these receivers now have a few years over their heads it's also prudent to check the condition of the h.t. smoothing block, which is under the front left side of the same unit. Since it faces forwards, it's necessary to remove the unit in order to do so.

A latch at the rear swings out to allow the unit to be raised provided the rear centre screw connecting the two top units is not fitted (remove it if it is). Swinging up the unit then shows one or more (depending upon the model) plugs and sockets under the unit. Normally there's one multiway plug (timebase supply) and perhaps a single lead off to the tuner supply. The majority of the contacts are carried by the left side strip connector. With this levered out, the power unit can be freed from its front fixings, one of which is spring clipped.

The condition of the four-tag, three-section electrolytic can then be examined. We don't wish to be side tracked into a servicing fault run down on this chassis, but we must nevertheless mention some of the faults that arise due to this item. In many cases it may have a suspicious looking bulge sticking out from the plastic. This in itself is reason enough to replace the unit. In other cases one or more tags may be corroded away and may be the cause of the raster looking like a couple of strips of horizontal illumination with wider dark hum bars between.

The nasty condition however is when the unit leaks electrolyte and this conductive fluid falls on to the bottom panel in the area of VT204, VT205, causing the picture to black out as the conductivity has the same effect as the beam limiter coming into operation. If it's caught in time, a thorough cleaning may be all that's required. Usually however several components have to be replaced before normal control of the brightness is restored. Now back to our basic theme.

If there's doubt about the cut-out, an a.c. ammeter connected across its tags will record between 700mA and 950mA if the receiver is working normally. If this current is recorded, it's in order to replace the trip. If the reading is much higher however there's a fault in the set and it may be found that the dynamic safety trip in the set (power unit) is operating due to an overload elsewhere (probably in the line output stage).

If the heaters in the tube neck are glowing, the overload cut-out cannot be at fault as the mains transformer must be functioning. This means that lots of other parts are free from suspicion, and a d.c. voltmeter will confirm that h.t. is present on the body (collector) of the chopper transistor VT604 (R2010) at the front left side of the power unit – provided R609 and R605 are intact of course. Thus the collector of the chopper transistor is being supplied, but if there's no 60V supply at the F603 (top centre of power unit) the chopper is not switching on.

No Chopper Output

For most practical purposes the chopper transistor can be looked upon as a line output transistor which is driven by a transformer (T602). If the transformer is inoperative, the base and emitter of the chopper will be at the same potential and therefore the device will be inactive. The drive circuit consists of a delay switch (VT602), a monostable multivibrator (VT603 and VT606), and a chopper driver stage (VT605), with attendant protection circuitry which spends most of its life inactive. The chopper's stabilised output supplies the line driver and output stages and the field and sound output stages.

The 30V Supply

Another stabilised supply (30V) supplies the line oscillator, field oscillator, beam limiter, audio, chrominance, i.f. and tuner etc. The control element here is VT601, whose base voltage is stabilised by the zener diode W605. Since VT601 is connected as an emitter-follower, its emitter voltage will be held steady.

Switch-mode Power Supply Operation

As we've already seen, a smoothed 240V d.c. supply is applied to the collector of VT604, which is switched on and off at line frequency. The on/off or mark/space ratio of the drive waveform is continuously varied by a feedback circuit which senses the output voltage and thus the load.

VT603 and VT606 form a monostable multivibrator circuit. This is a very similar arrangement to the bistable circuit we found in the Pye hybrid chassis' decoder (see Part 28), i.e. the two transistors are cross-coupled so that they drive each other. The difference is in the cross-coupling arrangements, and the practical effect is that one output pulse is obtained for every trigger pulse fed in as opposed to one output pulse for every two input pulses. The trigger pulses come from the line oscillator stage. VT606 drives

VT605 which in turn drives the chopper via T602. VT602 is included simply to delay the start-up of the circuit: it doesn't switch on until W605 starts to conduct. Note that there will be no chopper drive until the 30V rail has been established.

The trigger pulses are fed to the base of VT603 via C613 and W608. When a pulse arrives, VT603 switches hard on, its collector voltage falling to almost zero. As a result C614, which had previously charged via R612, and C615, which had previously charged via R621 and R637, are discharged. This switches VT606 and VT605 off. The important thing about this sequence is the time taken for it to happen. The discharge path for C614/C615 is via VT603/W607/VT602 on one side and R620 on the other. Since the value of R620 is fixed, the discharge time is determined by the charge C614/5 have previously obtained. By varying this charge we can control the on/off times of VT603/6/5 and thus the conduction-period of the chopper transistor. This is where the feedback action comes in.

VT608 compares the stabilised 30V supply at its emitter (via W620) and a proportion of the chopper supply present at its base (via W618 and the preset R629). The output it produces across its collector load resistor R637 is proportional to the difference between these two supplies. This voltage is applied to the charging network in the monostable circuit via R621, controlling the charge acquired by C615 and thus adjusting the monostable's timing and the drive to the chopper transistor.

Protective Circuits

There are two protection circuits, the dynamic trip and the crowbar trip. The object of the dynamic trip is to provide protection in the event of excess current demand. Excessive current demand will increase the ripple voltage at the junction of L601/W606. This ripple is bypassed to chassis via C610/R610. If excessive, the increased voltage across R610 will fire W622, short-circuiting the collector of VT605 and thus removing the drive to the chopper transistor. The effect is that the trip takes over part of the chopper's conduction period. The chopper's output voltage is thus reduced (say to about 55V) and the picture (if there is one) will be small and will fluctuate according to the excess current demand.

The crowbar trip provides excess voltage protection. Should the chopper's output voltage rise, due say to a leaky chopper or a fault in the drive circuitry, the result could be extensive and costly damage in the receiver. So the zener diode W617 is included to monitor the chopper's output voltage. If this rises above the diode's zener voltage (72V), W617 switches on. The resultant current pulse through R626 in turn switches on the crowbar thyristor W621. Since this earths the cathode of W602, the cut-out cuts out (or, in a few early production models, the fuse in this position blows).

Dealing with a Dead Chopper

This may sound very complicated and daunting if one is without experience, and indeed some of us with years of this valuable commodity get upset at times since it's not always obvious whether an overload fault is in this or that circuit. However, we are still concerned for the moment with the obvious fault condition that the chopper is inactive and there's no voltage at the 2·5A fuse F603 at the top of the power unit.

Now remember what we said about the chopper being inactive until the stabilised 30V line is established. This line is protected by the 500mA fuse F602 which is under the unit on the right side and is not too obvious. If this is intact, carefully check the actual voltage on it or at the emitter of the stabilising transistor VT601, which is bolted to the upper right side of the power unit. The voltage may well be a little under the correct 30V, as it's extremely common for C607 to dry up. C607 is the large 1,000μF, 63V electrolytic at the front centre. A replacement bridged across it will not always restore the 30V properly, and the replacement should be clipped in for test before the set is switched on.

If this capacitor is not at fault, and the 30V line is still low, check the regulator transistor VT601 itself (SP8385 or equivalent, say BD203) – if there had been an overload present, the 500mA fuse would have failed.

If the 30V supply is fully operative, the next item to check is the zener diode W605 on the front right side next to the 400μF C609. This zener diode will often be found open-circuit – or perhaps shorted. If it's open-circuit the delay circuit (VT602) cannot start up, whilst if it's shorted the delay switch transistor VT602 may be found damaged. If both W605 and VT602 have gone short-circuit there'll be no 30V supply of course. All these points can be checked in a few minutes.

Some others take longer. We know that the chopper drive circuit is triggered by pulses from the line oscillator, so we need to establish that the oscillator is working and that the pulses are arriving at 3/2 on the power unit (C613). The presence of these can be checked with a voltmeter with a simple diode probe. If they are not present our attention must be directed to the line timebase board, checking supplies (30V to R501 etc.), transistors and capacitors. It's not common for the line oscillator to stall altogether, and the circuit is relatively simple.

If the line pulses are present and there's 0·7V at the anode of W605 (and thus at the base of VT602), it's next prudent to check the 12V supply line to the chopper driver transistor VT605. A convenient place to check this is at the right side end of the large rear dropper (R607). If the 12V line is low it can be assumed that VT605 is either turned hard on or is defective.

In this case the voltage drop across W610 should be checked (VT605 emitter). If the voltage here is virtually the same as that at the supply point, the E1222 transistor should be checked for shorts (collector-to-emitter). If it's not shorted, the base voltage will be above 1V and VT606 and W612 should be checked. If there's no voltage across W610, this diode could be shorted. It could have been damaged by excess current through VT605.

Now we said it can be assumed that VT605 is either turned hard on or is defective. We said so because this is most often the case. It will be recalled however that the dynamic trip operates by pulling the collector voltage of VT605 down. This could be the reason for the low 12V supply, i.e. W622 could be shorted or turned on.

If the 12V supply is present none of the above applies and the next most likely offender is the chopper transistor itself. It can be checked in the same way as most npn power transistors – not forgetting the associated diodes (W606 and W609). Disconnect the base and emitter leads for a reliable check.

These notes have mentioned only a few of the possible causes of "no go" on the popular Thorn 3000 series of colour sets. There are lots of others, and if you look through past issues you will find them reported at length (see for example the September 1978 issue). Our object this time has been to give a rough outline of the line of attack to adopt, and why. Other makes and models require a slightly different approach as we shall see.

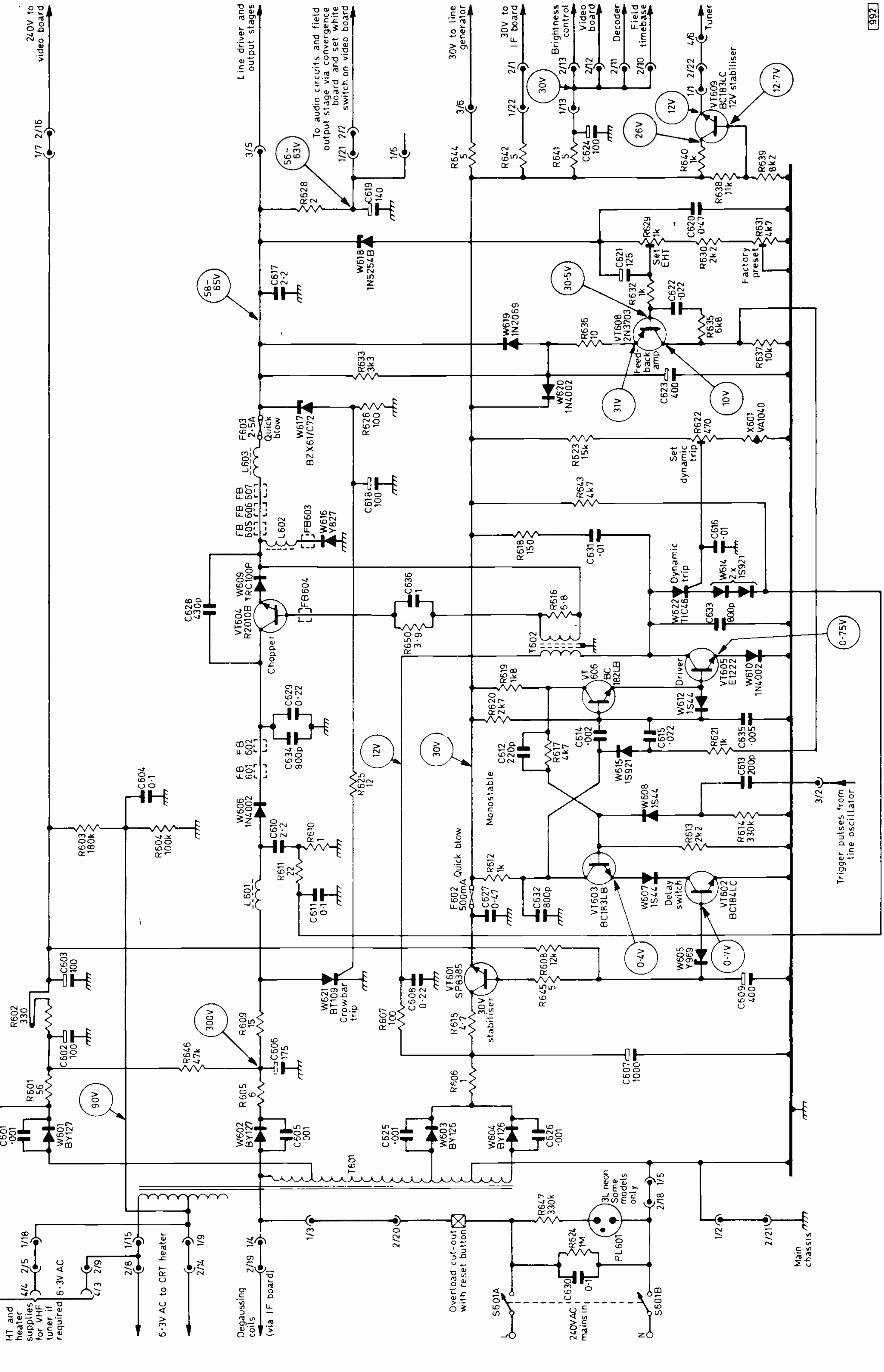


Fig. 1: Circuit diagram of the switch-mode power supply used in the Thorn 3000/3500 chassis. There were several minor variations in early versions.

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TV-VDU Conversion

Alan Kitching

OVER the past few years the uses to which domestic TV screens are put have multiplied. In addition to the display of off-air signals, TV games of varying degrees of complexity are now common, while an increasing number of sets are equipped for the display of teletext pages. Another use for the TV screen is as a VDU display. To adapt the domestic TV set for this purpose – and for teletext and TV games signals at video frequency – an interfacing circuit is required. The circuit described in this article was designed to fulfil this need. It enables common types of colour TV sets to be operated both as an eight-colour graphics/alphanumeric VDU under the control of an external TTL source and as a normal TV set as required.

The design uses twelve CMOS high-speed bidirectional switches. These are contained in three 14-pin DIL packages – types CD4066, CD4016 or equivalent – and are connected as six pairs of change-over contacts to switch between the set's R, G, B, luminance and sync signals and the corresponding signals from the system generating the TTL display (e.g. a teletext decoder, etc.). The design shown is flexible to cater for different types of sets.

Circuit Description

The circuit is shown in Fig. 1. By selecting the appropriate wire link and resistor/capacitor values, most types of colour sets can be interfaced. The switching elements are contained in IC1/2/3, each switch having its own control input. When this is at logic 0, the input and output connections are open-circuit. When the control input is at logic 1, the input and output connections are effectively linked via a low-value resistance – 80Ω in the case of the CD4066 and 300Ω in the case of the CD4016. The switches will pass frequencies higher than 10MHz, making them ideal for video switching, and as long as the supply voltage is kept at about 15V their operation is fairly linear.

The control inputs to the switches are provided by 7406 or 7416 high-voltage open-collector TTL gates – open-collector types are used since for correct operation of the switches the logic 1 voltage must approach the supply line voltage. The inputs to the TTL buffers are biased by resistors (R15 and R18) so that if no external circuitry is connected to the interface the CMOS switches are left in the TV position.

The three RGB TTL signals are each fed into one of the A inputs of the 74H87 i.c. (IC5). This type of i.c. is called a four-bit true/complement i.c., and is controlled by its B and C inputs. The operation is as follows. With the B and C inputs low, the signals at the A inputs appear at the Y outputs inverted. With the B input low and the C input high the inputs appear at the outputs without inversion. With the B input high, the outputs will be in the opposite state (i.e. the "complement" condition) to the C input regardless of the voltages at the A inputs. The truth table for this device is shown in Table 1.

It follows that the C input can be used to enable the interface system to handle either positive or negative TTL logic signals, and also to provide video inversion if required. The B input is connected to the TV/TTL select line so that the TTL RGB signals are held at either 1 or 0 (depending on the C input level) when the receiver is displaying an off-air TV signal: this prevents breakthrough of the h.f. component via the "off" CMOS switches.

The Y outputs from the 74H87 go to the TV/TTL signal matching circuit. The values of resistors R4, R5 and R6 are selected so that in conjunction with the 1kΩ presets the amplitude of the TTL signals can be matched to that of the TV signals in the receiver. It may be necessary to include capacitors C4, C5 and C6 in order to improve the h.f. response (essential in order to display the narrow verticals of the displayed characters). The three TTL signals are then capacitively coupled to the clamping stage which clamps the signals to the voltage set by VR2. The clamping action occurs during the back porch period of the waveform, VR2 acting as a brightness control for the TTL generated picture. The capacitively coupled off-air signals are clamped in the same way to the voltage set by VR1. The signals are not clamped to 0V because of the non-linearity of the CMOS switches when their inputs approach the supply voltages: raising the input voltage ensures linear operation.

After passing through the CMOS switches the signals are capacitively coupled via C1, C2 and C3 to the RGB output stages in the receiver. These capacitors may not be required in some chassis. The polarity of these electrolytics, and also the input electrolytics C7/9/11, will depend on the circuitry used in the particular chassis.

In some receivers the matrixing to produce the G – Y signal is carried out at a relatively late point in the RGB channels. An example is the Thorn 3000/3500 chassis. In such sets it's necessary to remove the R – Y and B – Y feeds to the G – Y matrix in the TTL mode, and to cope with this requirement two additional CMOS switches are included (IC3A and IC3D).

A further pair of switches (IC1D and IC2D) is included to enable the luminance signal source to be switched. This will be necessary in chassis using colour-difference tube drive. When TTL is selected, the luminance signal consists of a fixed voltage supplied by VR3. This control is used to adjust the d.c. conditions to keep the correct black level. When TV is selected, the luminance signal passes straight through unaffected.

If the TTL display is locked to an off-air signal, as with Ceefax and Oracle signals, the set uses the off-air sync pulses. The output from the set's sync separator passes straight through the interface board via IC3C. Where the display must be synchronised by an external source, a logic 0 is put on the sync source select (SSS) line. This disables

Table 1: 74H87 truth table.

Control inputs B	C	*Outputs* Y1	Y2	Y3	Y4
L	L	$\overline{A1}$	$\overline{A2}$	$\overline{A3}$	$\overline{A4}$
L	H	A1	A2	A3	A4
H	L	H	H	H	H
H	H	L	L	L	L

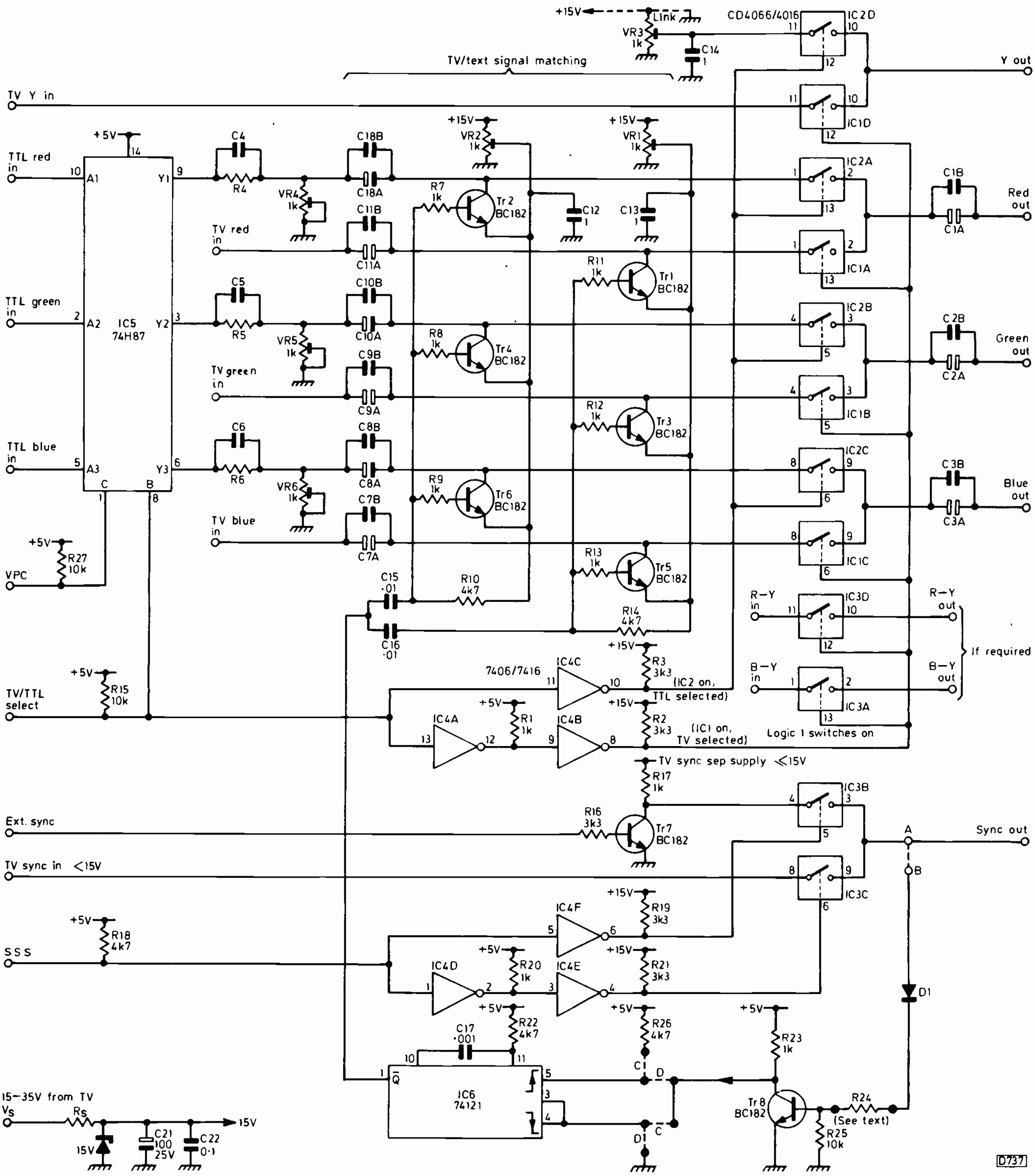


Fig. 1: Circuit diagram of the TV-VDU interface unit. The value of Rs in ohms is given by (Vs − 15V)/(20 × 10⁻³). SSS is the sync source select line and VPC the video polarity control line. Input to the monostable IC6: link C with negative-going pulses, link D with positive-going pulses. Link A-B if the set's sync pulses are less than 15V: if the sync pulses are greater than 15V, insert the sync feed at B. Reverse the polarity of D1 for negative-going input pulses.

the feed from the set's sync separator, feeding the external sync pulses in instead. These will have to be of the correct polarity of course. The sync select circuit operates in the same way as the video switches.

The external sync input drives the base of Tr7 via the 3·3kΩ resistor R16. The idea is to produce sync pulses of similar amplitude to those generated by the set's own sync separator. Note that the supply to the set's sync separator must not exceed 15V for this arrangement to work.

The sync output also drives the monostable i.c. IC6, via Tr8, so that it triggers on the trailing edges of the line sync pulses. The monostable's timing components R22 and C17 give an output pulse of about 3μsec width during the back porch period following the sync pulse. This pulse is coupled by C15 and C16 to the bases of Tr2/4/6 and Tr1/3/5 respectively, turning them all on to provide the black-level clamping. The clamp levels are set by VR2 (TTL) and VR1 (TV) and are decoupled by C12 and C13. This ensures a low clamp voltage source impedance, reducing interaction between the TTL and TV picture background brightnesses.

If the amplitude of the sync pulses from the sync separator in the receiver exceeds 15V they cannot be handled by the CMOS switches. In this case feed the sync pulses in at B and remove the link A-B. This bypasses the CMOS switches and drives Tr8 directly via D1 and the current limiting resistor R24. The value of this resistor must be chosen to give a base current of around 2mA with the peak sync voltage expected. If the sync pulses do not fall to chassis potential, i.e. they remain above about 1V, use a zener diode of suitable value, connected the other way round, in position D1. This serves to offset any minimum d.c. voltage present.

Conversion Procedures

Finally, let's consider some common TV chassis. The Rank A823, Decca 10 and ITT CVC5 chassis employ three identical driver/output RGB amplifiers, with capacitor coupling at the input and a feedback clamp. The inputs are positive-going at somewhat less than 5V peak-to-peak. The video switches can simply be inserted following the coupling capacitor.

In a number of chassis the RGB outputs are obtained from pins 2, 1 and 4 respectively of an MC1327 i.c. Insert the switches in series with these pins, after any load resistors connected to these pins. In the 8000 chassis (not the 8500) there are no load resistors at this point: add 10kΩ resistors to maintain the load on the i.c. (if this is not done, the input to the CMOS switches may exceed the specified limits for these devices). A similar approach can be used in chassis, such as the Philips G8, in which a TBA530 i.c. drives the RGB output transistors: connect the switches in series with the bases of the output transistors. In all these chassis there's d.c. coupling from the i.c.s to the c.r.t. cathodes. The easiest course of action therefore is to remove C1/2/3 from the interface circuit. The only change in the operating conditions in the TV mode will then be the addition of the series resistance of the CMOS switches. This will almost certainly be negligible. Since the signals are already clamped, Tr1/3/5 are not required. The TTL circuitry can remain unchanged, VR2 being adjusted so that the TTL black level is the same as the TV black level.

In the case of chassis using colour-difference tube drive the following approach is suggested. Insert the video switches just before the control grids of the three PCL84 colour-difference output pentodes. The TTL signal must be negative-going at this point to produce the correct display, and this can be achieved by placing a logic zero on the VPC line. The six capacitively-coupled signals can be clamped by Tr1-6 as before, but the clamp voltage should be about 6V. As C1/2/3 are now feeding a high-impedance input their values can be much lower. Remove the luminance signal by breaking the luminance path at a low-voltage point, using IC1D and IC2D.

The 12-15V supply required for the CMOS switches can be obtained from a suitable rail in the set, using a zener diode if necessary. The current drawn by the switching circuit is minimal.

For electrical safety reasons, an isolating transformer should be fitted in the set, after the mains on/off switch, with three-core cable for the mains supply.

This transformer could also have a secondary winding to feed a 5V regulator circuit for the digital circuits in the interface unit. Note that the 5V and 15V supplies to the interface unit must be maintained in the TV mode to ensure that the CMOS switches remain on.

Prototypes of the interface unit have been built and found to operate satisfactorily with several different types of receiver. Due to the time and facilities available however a PCB layout has not been devised.■

Service Notebook

George Wilding

When confronted with a set displaying a symptom which could be caused by loss of one of the supply lines, e.g. no sound, no field scan or no line timebase operation, it's helpful first to touch lightly each wirewound power resistor – especially if the set is new to you. A cold power resistor immediately indicates the area where the supply loss occurs, even if the component itself is not at fault. This can be done before getting out the meter to make fuse checks etc. Lightly fingering the contacts of a fusible resistor is another quick step – and much more certain than making a resistance check from the board print.

Thus when a set fitted with the Philips G11 chassis came along with the symptoms no sound but a perfect picture, we rapidly found that the fusible resistor R5046, which supplies the audio output stage, was open-circuit. Now in older sets deterioration of the soldered joint on a fusible resistor due to heat over a long period of time can result in it going open-circuit, but in newer sets a fusible resistor rarely goes open-circuit unless an overload current has been sustained for a short while. No short could be discovered however, so the only thing to do was to remake the resistor's connection and switch on again.

This produced good sound, but within minutes there was increasing distortion and R5046 opened again. The two BD131 transistors in the output stage could have been at fault, but we decided to start by making voltage checks following switch on. This revealed that the emitter voltage of the lower transistor rapidly fell from a near normal reading of 2V as the distortion increased. This could have been due to the transistor of course, but we noticed that its emitter bias resistor is decoupled by a 680μF electrolytic capacitor (C5054) which was also suspect. It could be quickly breaking down to become short-circuit on application of the normal working voltage. In fact this turned out to be the case. On removal it was found to be virtually short-circuit, a replacement restoring normal sound.

Weak Luminance

The fault on a Pye hybrid colour receiver was very weak luminance, which could nevertheless be adjusted by means of the contrast control. Now on nearly all colour sets the first suspect when the luminance signal is absent or very weak is the luminance delay line. In the Pye chassis this is between two video amplifier transistors (VT5 and VT6) on the i.f. panel – Pye refer to these stages as the first and second phase splitters. The 500Ω contrast control forms VT6's emitter load resistor, and there's a.c. coupling between the delay line and the base of this transistor, via a 50μF electrolytic (C36).

As a first step we checked the d.c. continuity of the delay line. It seemed to be o.k., so next we did a couple of signal injection tests. Applying the signal at the output end of the delay line resulted in very little response on the screen, but when the signal was injected at the base of VT6 there was ample response. This suggested that the 50μF coupling capacitor was failing to do its job, and on replacing it normal results were restored.

It Wasn't the Tube!

The picture on a set fitted with the Thorn 3500 chassis gave every indication that the tube had failed – low brightness, silvery highlights, poor focus and bad flaring on all three guns. The picture size seemed about right, so it was likely that the e.h.t. voltage was within limits. The symptoms had all appeared suddenly however, the picture being perfect before this. What could be responsible for this sudden change? Our first suspicion was inadequate c.r.t. heater voltage, possibly due to a poor electrical connection between the heaters and the mains transformer. But a glance at the tube neck showed that all three cathodes were at their normal cherry red.

Now a key to the conditions in the line output stage in this chassis is the voltage across R907 on the beam limiter board, since this resistor forms the earth return for the line output stage. The voltage was found to be well in excess of the correct 1·3V, indicating excessive current demand in the line output stage. We switched off and touched the back of the e.h.t. tripler, which turned out to be quite warm. Replacing it and readjusting the focus control restored a first class picture.

Incidentally although R907 is a wirewound resistor it has been known to increase in value, producing a dark picture due to the resultant beam limiting action. Being of such a low value (1·5Ω), its resistance is difficult to measure accurately. When suspect, the best course is to replace it.

Beam Limiting Systems

S. George

BEAM limiting is essential in a colour receiver in order to prevent the tube being overdriven and an excessive load being imposed upon the e.h.t. generating system – the line output transformer e.h.t. overwinding and tripler or diode-split line output transformer as the case may be. Since the e.h.t. system has a fairly high source impedance, excessive beam current will also reduce the e.h.t. and focus voltages, impairing the convergence and the picture focusing (which is equivalent to a large loss in h.f. definition). Beam limiting is not difficult to arrange, but for some reason it's a part of the TV receiver where considerable circuit variation is found.

In hybrid receivers the voltage across a small-value resistor in the line output valve's cathode circuit was generally used as a means of sensing the e.h.t. current. The idea is shown in Fig. 1. Transistor Tr1 is normally held non-conductive as a result of the bias applied to its emitter by R5/R4, the voltage obtained from the slider of the brightness control depending on the values of R1/R2/R3, the setting of R2 and the supply voltages. If the e.h.t. current and consequently the line output valve's cathode current exceed a certain level, the voltage developed across R7 will be sufficient to switch Tr1 on. Consequently its collector voltage and the voltage tapped from the slider of the brightness control will fall, reducing the beam current. Due to variations in the line output valve's cathode current etc. it's necessary to have an adjustable threshold control (R4) in this type of circuit.

In solid-state receivers it's usual to include the beam current sensing element in series with the earthy end of the line output transformer's e.h.t. overwinding. A well-known exception is the Thorn 3000/3500 chassis, where the sensing element consists of a small-value resistor between the line output stage earth line and the earth line for the rest of the receiver. In most receivers however you'll find a diode, resistor or capacitor in series with the overwinding to sense the beam current.

A very widely used system is to include a diode, which is normally forward biased, in series with the e.h.t. overwinding. The way in which this is done in the Thorn 9000 chassis is shown in Fig. 2. The diode concerned is W722, which is forward biased via R724 and R725. The beam current returns to chassis via the tripler, the e.h.t. overwinding, R719 and W722. Since W722 is forward biased, there will also be a current flow through it in the opposite direction, i.e. via W722/R724/R725. This current flow is set by the h.t. applied to R725 and the values of R725 and R724. With an h.t. voltage of 240V and R724/5 approximately 200kΩ, the h.t. current flow will be approximately 1·2mA (240V/200kΩ=1·2mA). So long as the beam current is less than 1·2mA, it will flow to chassis via W722. If the beam current exceeds 1·2mA however W722 will cut off. The beam current will then flow back to the h.t. supply via R724/R725, and the voltage at the anode of W722 will swing negatively. As a result, the voltage at the junction of R724/725 falls, biasing back the c.r.t. grids via R902 and reducing the contrast via R157.

For the sake of completeness, a further point about this circuit should be made. The tripler incorporates a clipper

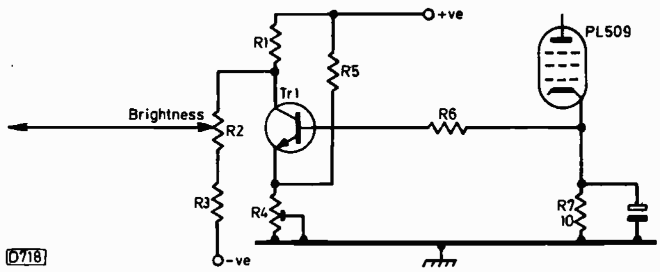


Fig. 1: Typical hybrid chassis beam limiter circuit.

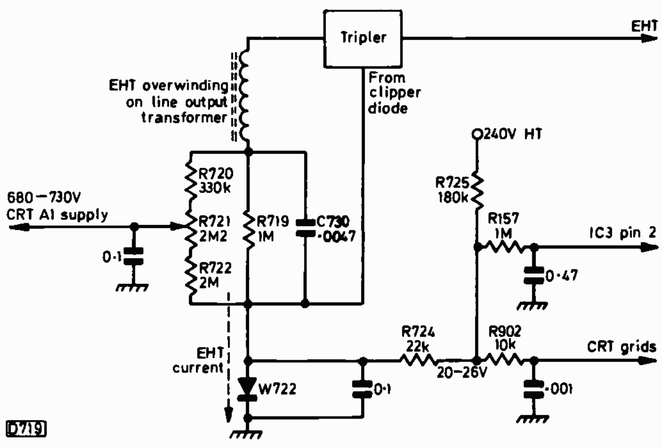


Fig. 2: Beam limiting in the Thorn 9000 chassis.

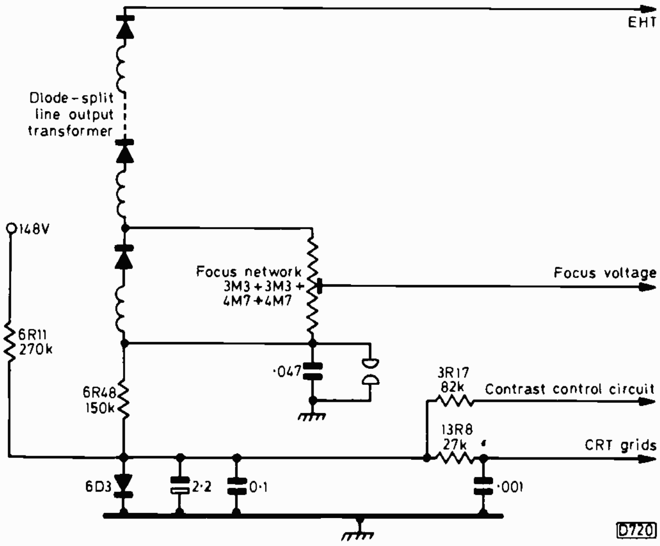


Fig. 3: System used in the Beovision 3502 chassis.

diode to remove the negative-going overswings following the pulse input to the tripler. As a result of the action of the clipper, C730 acquires a charge of about 1kV, i.e. the voltage at the junction of C730 and the e.h.t. overwinding is 1kV. This voltage is used to supply the tube's first anodes.

A similar circuit (see Fig. 3) is used in the Beovision 3502 chassis, this time with a diode-split line output transformer. An interesting touch here however is to incorporate 6R48 in series with the e.h.t. circuit and the focus control network so that the focus voltage tracks the small e.h.t. voltage variations that occur between minimum and maximum beam current. To maintain sharp focusing, the focus voltage should vary to a greater percentage extent than the e.h.t. voltage. At a high beam current level, the e.h.t. voltage will fall. The voltage across 6R48 will increase however. Since this voltage subtracts from that available at the focus tap on the diode-split line output transformer, there will be a greater percentage decrease in the focus voltage. The arrangement thus optimises the focusing at high and low beam currents.

At first sight it looks (see Fig. 4) as if the diode (CR709) in series with the e.h.t. overwinding in the Hitachi PAL-4 chassis is shown the wrong way round. Not so however. CR308 has 20V on its cathode, but its anode is biased from the 128V h.t. rail via R748. The voltage at the junction of R748/C743 is normally just over 20V therefore, and the e.h.t. current flows via the e.h.t. overwinding, L304, CR308 and the 20V supply. If the beam current exceeds the current

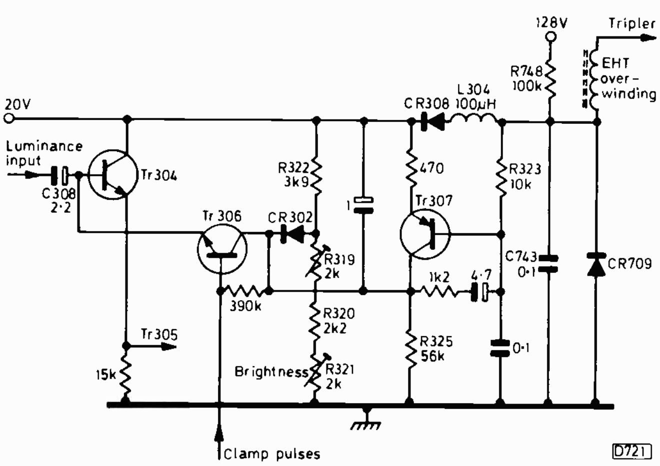


Fig. 4: Rather more complex – the Hitachi PAL-4 chassis.

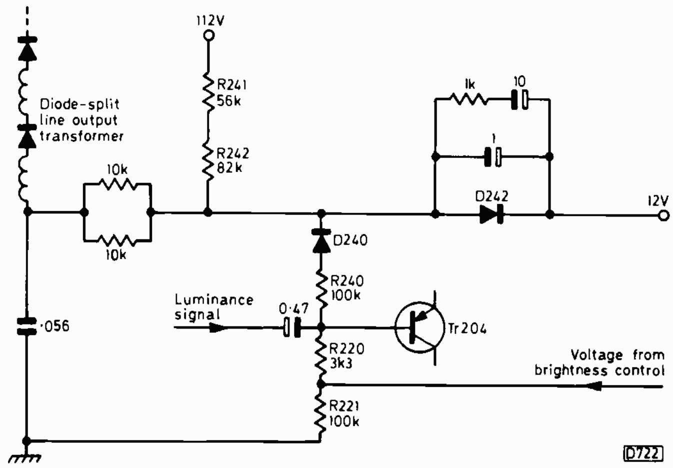


Fig. 5: Circuit used in the Rank-Toshiba T24E chassis.

flowing via CR308 to the h.t. supply, CR308 can no longer conduct. The voltage at the junction R748/C743 then falls, and CR709 switches on to provide the return beam current path.

The beam limiting action is provided by TR307, which is normally cut off but switches on when its base voltage falls below its emitter voltage, i.e. when CR308 switches off and CR709 switches on. TR307 in turn affects the clamping action at the base of the fourth video amplifier TR304. As can be seen, the luminance signal is a.c. coupled to the base of TR304 by C308. TR306, which is driven by line frequency pulses, provides the clamping action, returning the base of TR304 via CR302 to the junction of R322/R319 at the end of every line. C308 is thus charged to the voltage at the junction of R322/R319, which is determined by the settings of the preset and user brightness controls (R319 and R321), holding this charge during the active line period. When the beam limiter transistor TR307 switches on however its collector voltage rises above the voltage at the junction of R322/R319. CR302 is reverse biased therefore, and the voltage across R325 becomes the clamp voltage source. This reduces the brightness, i.e. the beam current.

This double diode approach seems to be favoured by Japanese set designers. Fig. 5 shows the arrangement used in the Rank-Toshiba T24E chassis. This time D242 provides the normal e.h.t. current return path, being biased on via R241 and R242. With excess beam current D242 switches off and the current flows via R242/R241. Since the junction of D240/R242 is now at a negative potential, D240 switches on. As a result the voltage at the base of the fourth video transistor TR204 is reduced.

Some chassis use a zener diode as the sensing element in series with the e.h.t. system. An example is the Decca 70

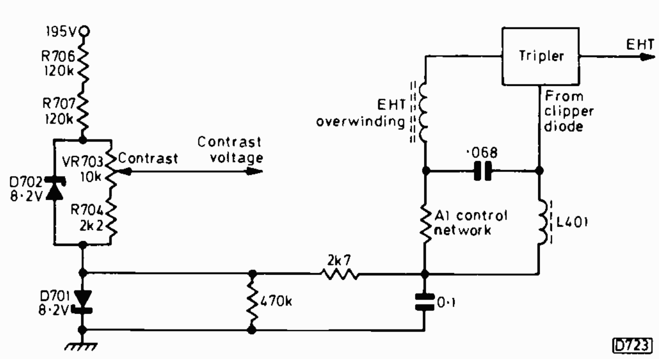


Fig. 6: Use of a zener diode for beam sensing in the Decca 70 series chassis.

series chassis (see Fig. 6). D701 normally acts as an ordinary diode, forward biased by R706, R707 and D702, thus returning the beam current to chassis. When the beam current exceeds the forward current flowing via D701 to the h.t. supply, D701 turns off and the beam current flows via the h.t. supply. When the voltage at the anode of D701 falls to –8·2V, D701 conducts in the reverse mode, clamping the voltage at this level through its zener diode action. Since D702 holds the voltage across VR703 and R704 constant, the beam current is limited via the action of the contrast control circuit.

The Philips G11 is another chassis that uses a zener diode. This time however (see Fig. 7) the diode (D6011) normally acts as a zener diode, holding the voltage at the junction of R3121/D6011/R6065 at 4·7V. With excessive beam current D6011 first switches off then conducts in the forward mode, clamping the voltage at the junction of R3121/D6011/R6065 at –0·6V. D6211, which is normally cut off, then acts on the brightness control circuit in the conventional manner. There's a second control mode in the G11 however. In the event of a heavy overload due, for example, to a short-circuit RGB output transistor, T4085/6 switch on. These then short-circuit the emitter of the control transistor (T4045) in the power supply, having a similar effect to the slow-start circuit. The result is to reduce the h.t. voltage substantially. The line output stage closes down, and the c.r.t. heaters, which are fed from a winding on the line output transformer, cool off. If there's no overload present, the h.t. will build up again. If there's a fault condition, the power supply will close down again and continue to cycle on and off.

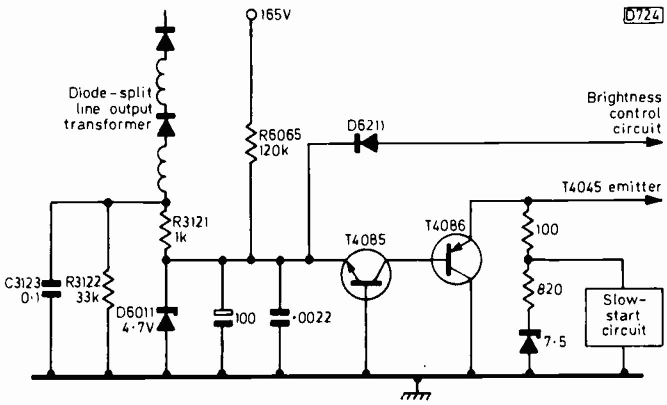


Fig. 7: The circuit used in the Pye/Philips G11 chassis has two modes of operation (see text).

These notes have highlighted some of the different approaches that have been used in dealing with this simple problem. Yet another way of going about it, with a capacitor as the sensing element, was described last month in connection with the Thorn TX9 chassis. Fortunately these circuits generally give little trouble. The zener diode used in the G11 chassis can go short-circuit however, removing the raster through the action of the beam limiter circuit, while lack of contrast in the ITT CVC20 series chassis is often due to a beam limiter circuit fault. In the latter event, check the diode D3 (which is used to clamp the action at –0·6V, not as the sensing element), the two 3·3kΩ resistors and the 0·033μF and 4·7μF capacitors. The 3·3kΩ resistors provide beam sensing in this chassis. ■

Servicing Zanussi Colour Receivers *Part 1*

Mike Phelan

A NUMBER of 110° Zanussi sets were imported during the early 1970s and are now available on the ex-rental market. They are 26in. sets of Italian origin, and have quite a pleasant appearance, with a push on-off switch, five slider controls and six square tuner push buttons. The tuning potentiometers and channel indicators – which can be rotated to bring a different scale into use when used on v.h.f. (with a different tuner fitted of course) – are behind the Perspex window. The usual model number is BR1026 (British Relay).

The chassis is entirely solid-state, with a thyristor line output stage. Most of the circuitry is arranged on two printed boards in vertical metal frames, with two fasteners at the top and bottom which can double as hinges or catches. The right-hand board contains both timebases and the raster correction circuits, the one on the left the signal circuitry and power supplies. The decoder panel plugs edgewise on to the latter panel. The convergence panel is hinged to the cabinet top, and has remarkably few controls for a 110° set. Despite this, it's possible to achieve very good convergence. Picture quality is fairly good, although earlier models suffered from faulty tubes with leakages from the grids to first anodes, and the tubes soon lost emission. Replacement tubes seem to be o.k. in these respects.

Brief Circuit Description

The power supplies are very simple. A bridge and two series regulator transistors supply the two l.t. rails of 22 and 22.5V. The h.t. is derived from the mains via a rectifier diode and thyristor. The latter has no control function, but is simply an over-current trip – more on this later.

The set uses colour-difference tube drive, with bidirectional clamps driven from the line output stage. The discrete component i.f. strip is quite conventional, feeding a TBA120 and TBA800 for sound, and a four stage luminance amplifier which is d.c. coupled throughout. A line-gated a.g.c. system is used.

The decoder uses only one i.c., a TAA630, which performs the functions of chrominance signal demodulation and G–Y matrixing. An untuned ident stage (T31) is used. This does not drive the colour killer. Instead, the killer turn-on voltage is obtained from a phase detector (D16/17) which compares the burst and the reference oscillator output – as in the burst phase detector (D13/14), except that the reference carrier is shifted 90° so that the detector gives a *negative* output when the oscillator is locked to the burst. A similar arrangement is used in the Philips G6 chassis. The killer voltage drives a two-stage switch (T29/30) which controls the turn-on bias for the chroma delay line driver (T34) and for the 4·43MHz notch filter (L16) in the luminance channel.

The field timebase uses a complementary-pair (T43/44) oscillator which behaves as an SCS. This (unusually) charges a capacitor during the flyback stroke. During scan the capacitor (C213) is discharged by a Miller (should be a

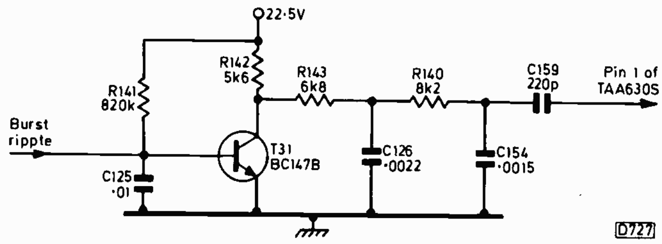


Fig. 1: The untuned ident stage in the decoder. The 1·3V squarewave output is fed to pin 1 of the TAA630S chrominance demodulator/G – Y matrix/PAL switch i.c.

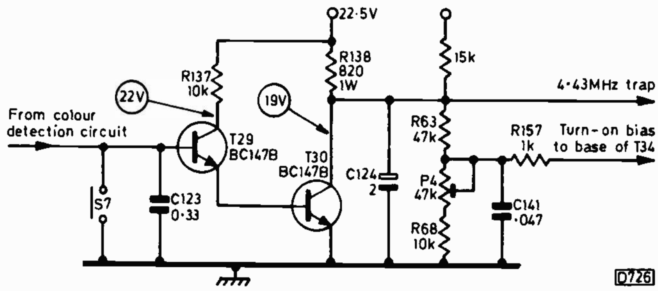


Fig. 2: The two-stage switch which provides the colour-killer action. In the absence of a colour signal, the two transistors are biased into conduction, the voltage at the junction of R138/R63 thus being reduced. To override the colour-killer, add link S 7 to remove the bias from the base of T29. With a colour signal present and the reference oscillator locked to the burst, the synchronous colour-killer detector D16/17 provides a negative-going output to switch T29/30 off.

Blumlein) integrator (T45) to provide a linear sawtooth. This is amplified and fed to a quasi-complementary output stage using the ubiquitous 2N3055. The 32V supply comes from the line output stage.

The line output stage is of the thyristor variety, whose principle of operation has been excellently explained several times in these pages. The drive pulse comes from a TBA920

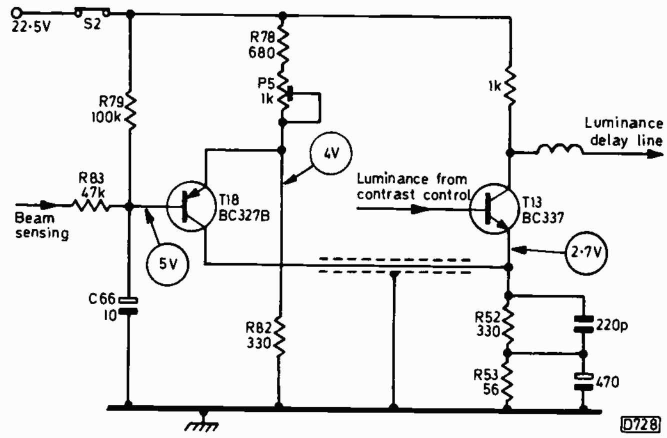


Fig. 4: Method of beam limiting. The beam current is sensed by diode D49 which is connected in series with the earthy end of the e.h.t. overwinding (see line output stage circuit next month). R79 forward biases D49, and the beam current limiter transistor T18 is normally cut off. In the event of excessive beam current, D49 ceases to conduct and the reduced voltage at the base of T18 switches it on. T18's collector current flows through R52/53, thus increasing the voltage at the emitter of the luminance delay line driver transistor T13. T13 is thus reverse biased, and since d.c. coupling is maintained to the c.r.t. cathodes the brightness is reduced.

followed by two transistor stages (T39 then T38). The line output transformer is really no such thing: its functions are to supply various pulses, including the 8kV for the tripler. The scan coils, as in most such timebases, are directly connected to the scan thyristor (Th3) without any impedance match.

EW raster correction is carried out by a transductor (TR7) which is connected across part of the line output transformer. The primary of the transductor forms the load of a stage (T59) that's driven by a field-rate parabola. NS correction is obtained by modulating the field sawtooth with

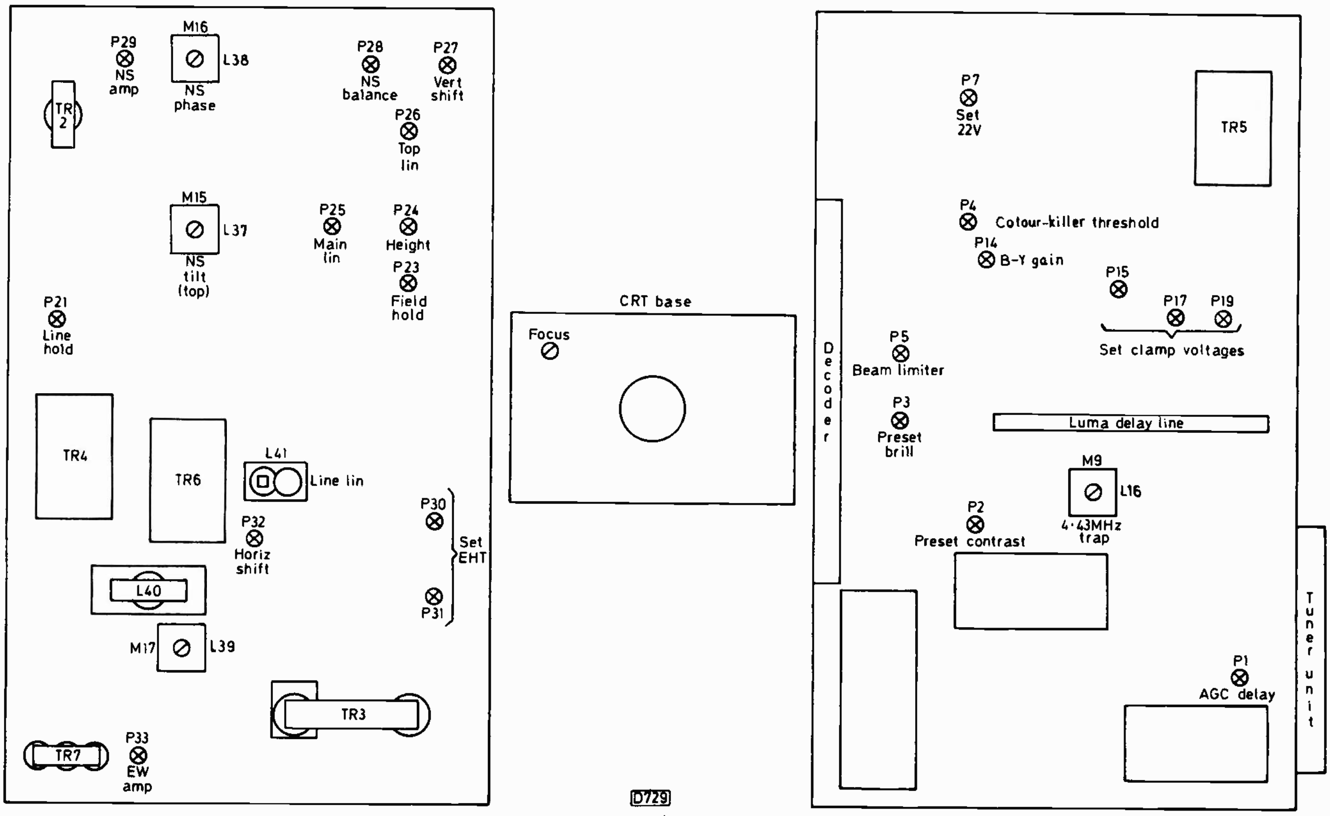


Fig. 3: Control layout, Zanussi Model BR1026. Boards viewed from the front (component side).

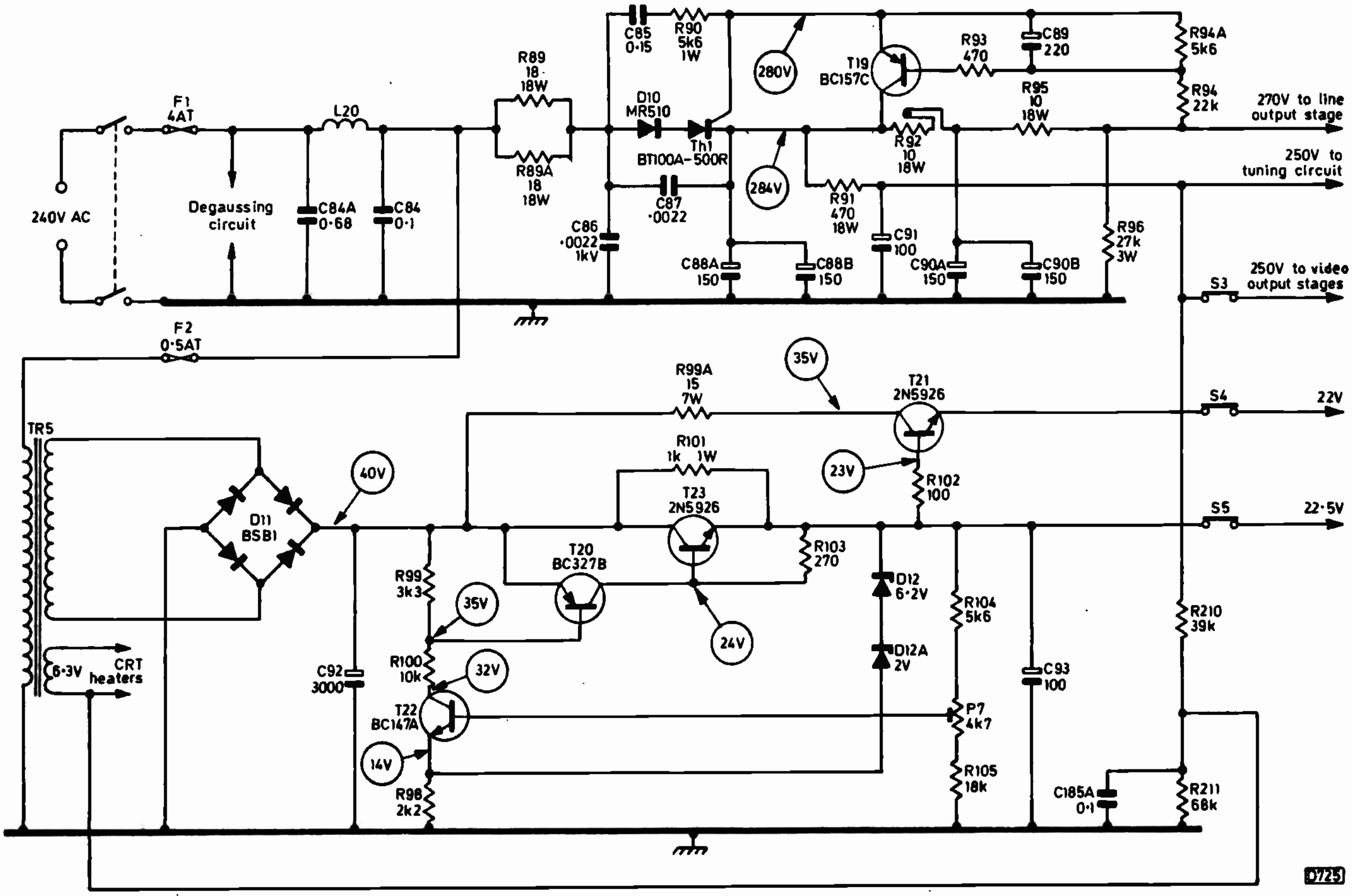


Fig. 5: The power supply circuitry used in the Zanussi Model BR1026. 270V and 250V h.t. supplies are derived from the mains by half-wave rectification, thyristor Th1 acting as an over-current trip. The 270V line supplies the line timebase, the 250V line supplying the luminance output transistor (T16, BF338) and the three colour-difference output transistors (T35/6/7, type SE7056). Series regulators stabilise the 22V and 22·5V l.t. supplies.

line flyback pulses, applying the resultant waveform to a tuned circuit (L38/C235) which feeds a class B output stage (T53/56). The latter is transformer coupled (TR2) to the field scanning circuit.

Power Supply Faults

Due to the simplicity of the power supply, nothing much goes wrong here. The 500mA fuse F2 will blow if the mains transformer (TR5) or bridge rectifier (D11) has gone short-circuit. A short on either l.t. rail will not blow any fuses as the regulator will simply turn off. Actual regulator faults are rare, but the driver transistor T20 occasionally shorts, causing a 100Hz hum-bar. Erratic variations of size, brightness and contrast, due to slight variations of the l.t. supply, will be due to D12a (2V zener) being defective. Replace with two or three silicon diodes in series, and adjust P7 for 22V at the emitter of T21.

When the mains fuse blows, the cause could be one of the many mains filter capacitors, though it's unlikely on this chassis. Generally it will be found that replacing the fuse restores the set to apparently normal operation, but that after a few switchings-on the fuse goes bang again! To explain the reason for this, it's necessary to say a few words about the trip circuit and the reason for having it.

The cycle of operations in the line output stage is initiated by a pulse fed to the gate of the commutating thyristor (Th2). This starts the flyback, by completing the *LC* commutating circuit whose capacitors (C249-51) had previously charged from the h.t. supply. When the set is switched on, it's possible for the commutating thyristor to be fired before anything else has had a chance to happen, i.e. before the commutating capacitors have charged. If this occurs, the cycle of operations goes no further and the thyristor stays on. We now have an h.t. short, and the excess voltage developed across R92 and R95 turns on T19, which in turn connects the cathode of Th1 to its gate, shutting down the h.t. This is the trip action.

When the smoothing electrolytics have discharged, the voltage across R92 and R95 falls and the power supply starts up again. If the reason for the trip was simply because of the line timebase not starting correctly, all will be well as the reset trip brings up the h.t. gently. If there's a fault however the tripping will continue, at a rate of about 2Hz, making a very pronounced thumping noise, until R92 springs open.

The point about all this is that if the trip is not working the mains fuse may blow, but not every time the set is switched on and never once it's running. The usual culprit is Th1, which will show leakage on an Avo if faulty. T19 sometimes goes open-circuit with the same result.

The large wirewound resistors in the power supply get very hot during normal operation. If the set appears to be working normally but either of the surge limiters R89 or R89a, both 18Ω 18W, has got so hot it's unsoldered itself, check the other one – it will be stone cold and open-circuit. It's worth mentioning that the print in these receivers is virtually indestructible.

If tripping occurs at a rate of about one cycle every five-six seconds R95 has gone open-circuit, R93 and R94 attempting to supply the set. When renewing any of these resistors, the new one must be adequately rated *and* supported.

CONCLUDING PART NEXT MONTH

Computerised TV

Part 2

David K. Matthewson, B.Sc., Ph.D.

IN Part 1 we gave a brief description of the main sections within the TMS1070 microcomputer i.c. which Sanyo use as an off-air timer and tape counter in their VTC9300P videocassette recorder. Time to go deeper into the subject, the obvious starting place being the ROM since this controls the basic operation of the i.c.

Carrying out the Programme

The ROM is the memory that holds the programme instructions for the microcomputer – the total number of instructions the ROM can hold is 1,024, each consisting of eight bits. The programme starts at a fixed point after switching the equipment on, a shift register then going through the programme, giving sequential access to each instruction in the ROM. Remember that the instructions are arranged in 16 "pages", with 64 instructions per page.

Forty three instructions control the inputs, outputs, constants from the ROM, bit control, internal data transfer, arithmetic processing, branching, looping and sub-routines. For maximum efficiency, each 8-bit instruction word can control 256 operations. The instructions are built into the i.c. – determined by the mask configuration.

When a "branch" or "call sub-routine" instruction occurs, the programme switches to the appropriate routine, the 6-bit programme counter (see Fig. 2 last month) address being used to effect the change. The sub-routine return register stores the return address, so that at the end of the sub-routine the main programme is resumed.

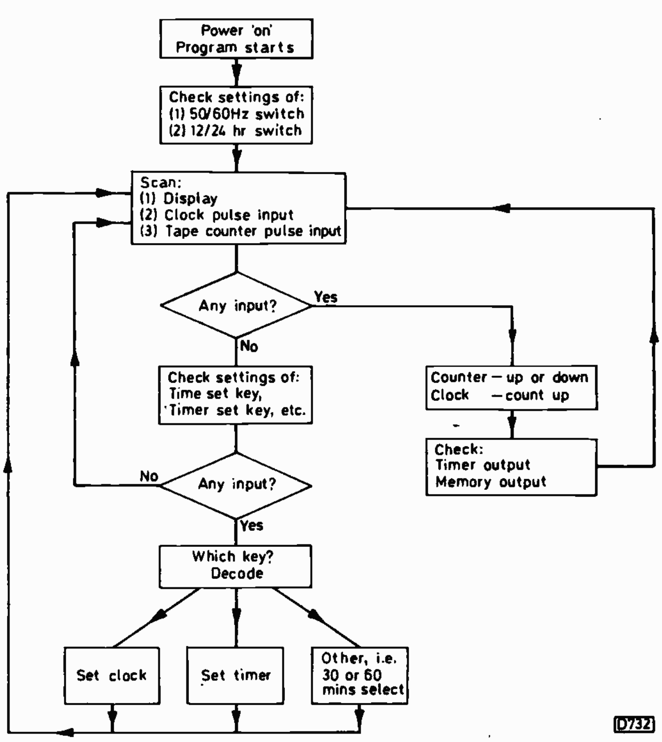


Fig. 4: Flow chart of the TMS1070 microcomputer's programme. The microcomputer starts at the top, then carries out each operation in turn. The whole cycle takes less than 1 × 10^{-3} seconds.

Fig. 4 shows the flow chart of the programme used in the VTC9300P, and illustrates the branching and looping.

The page address register holds the address of the ROM page in current use – one of the 16. To change to the next page, a constant from the ROM is sent to the page buffer register. Then, when an appropriate point, i.e. branch, is reached in the programme, the page buffer register tells the page address register to change page. The page buffer register also holds the return page address so that at the end of a sub-routine the programme returns to the appropriate page.

The storage space in the RAM consists of 256 bits, each with a unique address code for access, arranged as four "files", i.e. each file consists of 16 4-bit words. Access to the RAM is via the X and Y registers: the Y register selects any one of the 16 words in a file, while the X register selects the required file. The Y register is controlled by the arithmetic logic unit.

A typical ROM instruction will set Y to a constant, compare Y with a constant, transfer data to and from Y and increment or decrement Y. The X register can either be set to a constant or complemented (the inverse of the constant). The incoming 4-bit data word will typically be sent to the RAM location set by the X and Y registers, then returned to the arithmetic logic unit to be operated upon, then sent back to the Y register or to the accumulator. All this happens during one instruction interval (20 $^{-6}$ sec).

Operation of the Arithmetic Logic Unit

The working heart of the microcomputer is the arithmetic logic unit, which performs the logic and arithmetic operations. These are carried out by the 4-bit adder/comparator (see Fig. 5) which has two inputs, N and P. The P inputs consist of a constant, i.e. instruction from the ROM, the K input data (from outside the device), an input from the RAM and from the Y register. The N inputs consist of the constant and K input lines, an input from the RAM and from the accumulator. One of the outputs from the accumulator passes via an inverter, thus allowing subtraction to be carried out. As the words indicate, the adder/comparator adds or compares the data fed into it – each input consists of a 4-bit word. The output information

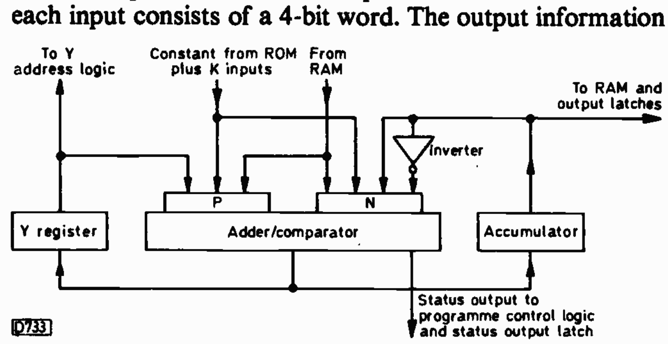


Fig. 5: The arithmetic logic unit's inputs and outputs.

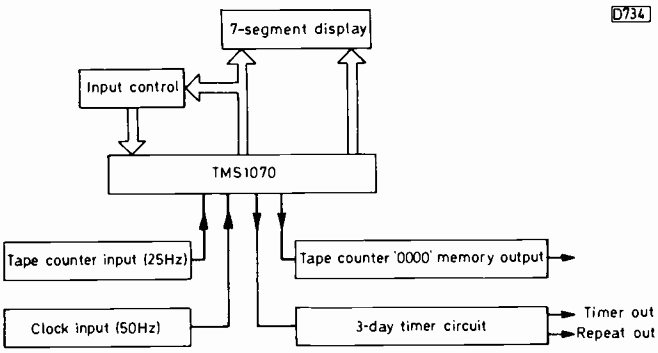


Fig. 6: Use of the TMS1070 in the Sanyo VTC9300P VCR.

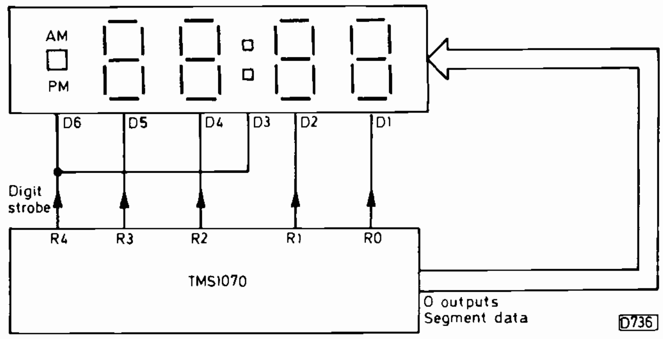
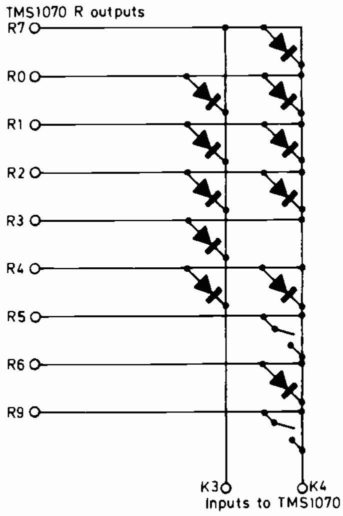


Fig. 8: Driving the fluorescent display.



Outputs	Inputs	
	K3	K4
R7	Not used	Indicates that a cassette is loaded
R0	Either clock or counter mode	VCR power on
R1	Minutes set or counter reset	Recording period = 30mins
R2	Hours set or 'memory on'	Recording period = 60mins
R3	Timer set	Not used
R4	Clock set	Counter up/down
R5	Not used	60/50Hz select
R6	Not used	'Sleep' input
R9	Not used	12/24 hr select

D735

Fig. 7: Arrangement of the input control system.

from the adder/comparator is stored in either the Y register or the accumulator. A "carry" output, or the result of a logic comparison, is fed to the status output latch.

When an arithmetic or logic comparison is "carried" the programme is affected by the status bit output but the Y and the accumulator registers are not affected. The normal state of the status signal is a logic one, which means that the branching or programme procedure called for is carried out. If a programme instruction requests a carry output to the status latch and the carry doesn't occur, the status signal goes to zero for the duration of one instruction cycle. This also occurs when a logic comparison giving an equal result occurs. The effect of the status signal being at zero is to prevent a branch or sub-routine occurring, i.e. the previous instruction is repeated.

The four K inputs are connected to the adder every time the programme requests an input word. The inputs are either tested for their logic state (one or zero) or stored in the RAM for later use.

Microcomputer Outputs

There are two multipurpose output channels, R and O. The R outputs can be used to multiplex the inputs and to strobe the O outputs – an example of the latter was shown last month, for obtaining a seven-segment display. Since the R outputs can be set or reset individually, one can be used to strobe the others – this allows the Y register to select each latch in turn, the variable R outputs then being set or reset and finally the data strobe R output latch set.

The eight O outputs are encoded by the O output latches, each of which contains five bits. Four of these come from the accumulator, the fifth coming from the status latch (in turn from the adder output). When the instruction "load output" is given, these five bits are sent to the five output latches. They are then sent to the O output programmable logic array, which consists of 20 programmable input NAND gates. These in turn select any combination of O0-O7 as the output. The programmable logic array is set up by the user during programming: driving seven-segment displays is a typical use for this feature.

Use in the Sanyo VTC9300P VCR

That sums up the basic operation of the TMS1070. Let's see what Sanyo do with it in the VTC9300P, where it acts as a tape counter and off-air recording time clock. Fig. 6 shows in block diagram form the way in which the TMS1070 is used for these purposes – it's interfaced with a seven-segment fluorescent display.

The input control block selects either of the two functions – timer or counter. It consists of a series of switches connected between the R outputs and the K inputs (see Fig. 7). Strobe signals come out of the TMS1070 via the R outputs and, depending on which external switches are on and which off, are fed back into the TMS1070 via inputs K3 and K4. The strobe signals are also used to drive the seven-segment display – more on this below. The system of feeding the signals back into the i.c. in this way enables the TMS1070 to find out which function has been selected. The strobe time is about 117Hz, so the microcomputer is in effect checking whether a new function has been called for 117 times a second.

The other inputs to the i.c. consist of 50Hz clock pulses derived from the mains – these are fed in at K1 – and 25Hz tape counter pulses derived from the video head drum's rotation – these are fed in at the K2 input.

As well as strobing the input control selection switches, the R outputs also strobe the digits of the seven-segment display – they are effectively equivalent to digit drivers, with the O outputs the segment drivers. Fig. 3 last month showed how the seven-segment information is encoded by the O output programmable logic array: the connections between the TMS1070 and the fluorescent display are shown in Fig. 8. The TMS1070 differs from the basic TMS1000 in having high-voltage (35V) outputs which interface with fluorescent displays directly.

The tape counter memory circuit (Fig. 6) is an interface between the TMS1070 and the VCR's control logic, and is used to stop the VCR when the counter reads "0000". The three-day timer block consists of a dual JK master/slave flip-flop which enables the output pulse from the TMS1070 (the pulse that tells the VCR to start an unattended off-air recording) to be delayed by up to three days.

We've already shown (Fig. 4) the programme used in this application of the TMS1070.■

I'll See You Again

Les Lawry-Johns

I was singing away to myself and to (the annoyance of) the cat and dog when a rather familiar car drew up outside. It was the car of the scatterbrained blonde from one of the shops in the town (I can't be more explicit for fear of libel). She came crashing in through the door.

"Oh dear, you'll never guess. It's gone again, right in the middle of the film last night. Isn't it terrible? Just about everything that can go wrong has done. Now this. I was only saying to my daughter last night, the sooner your father comes home the better. He's only been away three months, and literally everything's gone wrong. If it isn't the car it's the central heating, and if it isn't that it's something else. Now the telly. My dear you'd never believe it. Men have no right to leave us for more than a few hours. It's all left to me. My daughter put her coat on and went out as soon as I started to tell her about the freezer going soft because the vacuum cleaner had knocked the switch up the day before."

I reeled before the onslaught as she paused to draw breath, and was relieved to see my wife appear on the scene to find out what all the fuss was about. She had to listen while I escaped to get the set out of the car.

Mrs. Brashley got her second wind, and continued her tale of woe. Apparently she'd knocked the wing of her car, and whilst it was being repaired she'd got her husband's car out in order to keep it in good running order and just as she was in a stream of cars approaching some traffic lights she happened to glance down at the birthday card her husband had sent her and consequently she didn't notice the cars in front slowing down as the lights changed and this was how her husband's car had a nasty dent in the front. It was all pure bad luck and there seemed no end to it.

It'd Gone Pop

By this time I had the set up on the bench and the rear cover off. It was a 26in. Pye of the 741 ilk (725-731, with vertical panels and all that). By the time Mrs. Brashley had related the sad tale about the water dripping through the bedroom ceiling, I had the filter capacitor replaced, a new fuse fitted, the set tested and had put it back in the car. She hadn't noticed any of this and finally remembered why she's come.

"Would you be kind enough to get the set out of the car for me? I'll call for it later."

"It was your set I was doing while you were chatting dear. I put it back in the car so you won't have to call back later." I was wrong, so wrong.

An Elusive Hum

Although this next one concerns a unit audio, it could well concern a TV set – and not only from an audio hum point of view. It was a Ferguson unit, using the 78S chassis. The complaint was severe hum on one channel only. This was confirmed on test, and the hum remained severe at minimum volume setting.

Since the other channel was not affected, the power supply and smoothing were assumed to be in order. Some time was spent identifying the relevant components etc. in the defective channel, and it was found that the hum was getting in at the base of the preamplifier transistor immediately following the volume control. This was rather disconcerting, since the control was at minimum and the only components between it and the transistor's base are an 0·1μF capacitor in series with a 1kΩ resistor. The base is biased by a couple of resistors between the negative supply and the positive return, the supply lines being common to the other channel.

A test electrolytic from the transistor's base to the positive line removed the hum, thus proving that it was not entering the circuit later. The transistor was removed and proved faultless. The resistors were unhooked from the base contact and proved correct, as were the small correction capacitors in the circuit. When these items were refitted and the unit was switched on again the hum could hardly be heard. This seemed strange, since nothing had been found at fault.

Not wishing to quarrel with our luck, the unit was reassembled and when the last screw had been refitted it was tried again. The hum was there, buzzing away like an angry bee on one side while the other side maintained a discreet silence until the volume was advanced when it related how it spent a lovely day at Bangor.

Out came the screws, out came the unit, and we started all over again. Voltages tested, capacitors checked, even when they couldn't be at fault. At last we removed all the components from the base circuit of the suspect preamplifier transistor. It was only then that we saw it. The end of one resistor (the 1kΩ one from the base to the 0·1μF capacitor) had a greenish tinge, with more green on the lead out. It was close up on the panel to the main smoother, and a bright light directed on to the component side of the panel showed a damp area. It was only when the electrolytic smoothing capacitor was removed that we were able to see where it had been leaking.

A clean up and a new capacitor restored hum-free operation, but we were not quite able to see why the hum had been so severe, with the voltages apparently not affected. But then there are many things we don't understand. For example . . .

This Time it went Bang

Mrs. Brashley phoned later to say that the set had functioned beautifully for a couple of hours and then gone bang (not pop). Back it came, and when we looked at the print side of the power board there was a blackened area on the lower right side where one tag of the input choke had been dry-jointed and had been sparking. The glass of the 3·15A mains fuse was missing, leaving only the end caps, so as she said it must have been a pretty hefty bang.

With the connections properly made and the panel cleaned up, it remained to find out what else had suffered. The items next to the explosion area provide over-voltage protection (see Fig. 1): the BC147 transistor VT881 was shorted, also the 7·5V emitter zener (D884). These were replaced and the set tried, but the h.t. wouldn't come to life. Checking the circuit showed that the collector of VT881 is connected directly to the trigger diac D892 and diode

D901. The latter was short-circuit, replacement bringing things to life.

The picture was now horribly grainy however, and although the tuner could have been at fault we were more inclined to suspect the i.f. filter and gain module. We normally plod through these with a soldering iron, but one's always left with the feeling that the repair may be only temporary. As it happened we had one of the replacement units especially designed by LEDCo and supplied at a very reasonable price. It looked good and when fitted performed very well indeed, so we had the comfortable feeling that at least the set wouldn't come back to us on this score.

Mrs. Brashley came to collect her set, and told us about her freezer, vacuum cleaner, her husband's car and her garden fence which had fallen on to her neighbour's prize flower bed. When she'd gone I told my wife how lucky she was to have a husband around, and she said she wasn't so sure because when I wasn't around she got an awful lot of interesting things said to her by the male customers. Things they didn't say when I was around. So I thought I'd better not take so long to do those outside jobs in future, even though that would mean I wouldn't have so many interesting things to report to readers, like Mrs. Smallpiece, Laura Lovitt, Pretty Loose and all.

Back to Back or Front

As it happened, I did have to nip out to have a look at a set which was too big to be brought in. It lived at my bookmaker friend's home, which as you may remember is back to front (the house, not my friend). You stop on the forecourt, go through the garage and ring the back door bell, because there's no path round to the front of the house (actually there is, but I think it's secret and there's no point in looking for it anyway and everyone uses the back, especially strangers, because there's a deep swimming pool round the front and there isn't any water in it you see).

Well, in we went to see the non-working set. Actually they have two Dynatrons, both 26in., one with a videocassette recorder built into the top. This was the one that wasn't functioning.

It just had to be fitted with a Pye 741 chassis just like Mrs. Brashley's (actually a 733). So without much ado I removed the two hundred and fifty screws that secure the rear cover and leapt straight at the right side power panel. The mains fuse was intact, and as there was no sign of distress I plugged in and saw the neon on the front panel light. There was also an initial buzz from the set, indicating that power had come in but had gone somewhere or the other. Otherwise, nothing.

I wonder what's at the centre h.t. fuse F971 (see Fig. 1)? Nothing. I wonder what's on the 3·3Ω wirewound which sits on top of the centre housing (R978). About 35V at each end! Ridiculous, I thought. You just can't have such a silly figure. But it was there. I switched to a.c. and checked on the body of the thyristor. 240V.

It was at this point that I remembered I'd forgotten to bring the service manual. I started to panic as I crouched behind the set with my nice new shoes and all creased up. Stop it, I told myself sternly. Think logically. If there's 35V at the 3·3Ω surge limiter resistor, why isn't it on the h.t. fuse which is only two sections (R972/3) of the dropper away? One section must be open-circuit. It was: R973 (56Ω) was indeed open-circuit. This wasn't of much comfort however because there should have been over 180V on R978 – since this was intact and charges the main reservoir electrolytic C880, yet there was definitely only about 35V when tested.

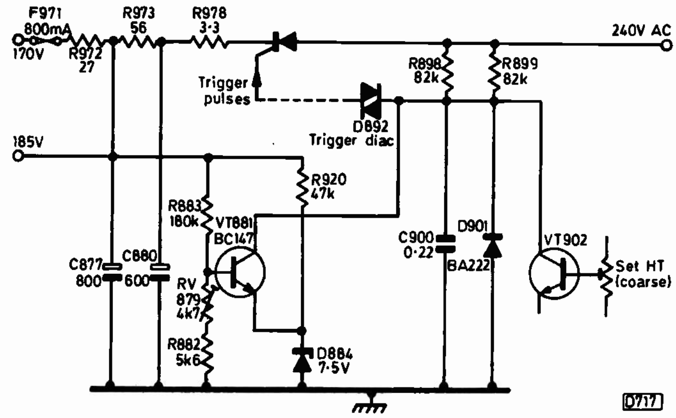


Fig. 1: Simplified circuit showing the trigger pulse charging and overvoltage protection arrangements used in the Pye 731 series chassis' power supply. C900 charges via R898/899 to produce the pulse that fires the diac and hence the thyristor, D901 being included to remove the negative-going excursion of the mains waveform. The charging of C900 is controlled by VT902. The overvoltage protection transistor VT881 supplements this action in the event of excessive h.t. voltage – it conducts should the voltage at its base exceed the 7·5V at its emitter set by D884, thus further delaying the charging of C900 and the pulse provided by D892. The result is very obtrusive variations in picture size as the h.t. rises and falls. A very similar circuit is used in the Philips G8 chassis (early versions of the 731 chassis use a crowbar type overvoltage trip circuit).

When the dropper had been replaced we tried again. Now there was no voltage at all, so the 35V had merely been the charge left on the reservoir capacitor when R973 had gone open-circuit the previous day. But why no h.t. now? Clearly the thyristor wasn't firing, since it had the full a.c. on its anode.

So we prodded around with the voltmeter, suspecting an open-circuit resistor or diac or something. All checked out o.k., and much time was spent trying to find the missing link. Due to the absence of the circuit however I couldn't put together one or two vague bits of uneasiness which were dogging the search.

By this time the panel was flat down and every suspect had been checked. My knees and legs were aching, and I just had to get up and stretch. My bleary eyes then caught sight of a rectangular box lying free on top of the set between the photographs. The sickening realisation dawned. I slapped the panel back in, plugged in again and rocked the standby switch on the remote control unit. The set burst into life as the thyristor was triggered, and I made a mental note to look up the remote control circuitry when I got back to the ranch.

The proud owner appeared and commented that he'd just come to tell me that the remote unit was on the top of the set where I might not see it. Oh yes, and while I'm here would I have a look at the other set as the picture was intermittently grainy. It was the i.f. filter and gain module of course, which had to be removed and resoldered here, there and everywhere. We didn't have another LEDCo replacement with us, so we just had to persevere with the coils and capacitor legs, finally achieving satisfactory results and replacing the three thousand screws on the back cover. Footsore and weary we beat a hasty retreat through the kitchen and out to the front, er back, and roared off down the drive.

Jacko and the Wee Lass

No sooner had I got back than the phone rang and I was scared stiff in case it was Mrs. Brashley. It wasn't. It was

Mr. Jackson who had bought a 22in. Pye hybrid set from us some years ago.

"Can I bring the set up Lawry?" he enquired.

"Certainly Mr. Jackson. At your convenience, so long as it's at mine as well."

"O.K. Lawry" said the bonny Scots laddie. "See you soon. And by the way, give that wife of yours a kiss and cuddle for me will ye?"

"Do your own dirty work" I retorted, mortally offended. I put the phone down and turned to Delilah.

"It makes me sick the way you flirt with all the customers" I complained. "And under my very eyes too. No one seems to be afraid of me any more You just wait till Jacko comes in."

Well Jacko came. Brought the set in. Put it down and by chance my honey bunny happened to be passing through at that moment and received the kiss and hug he had threatened. It's a good job I was busy at the time I can tell you. There are going to be some changes around here.

"Mr. Jackson" I said icily. "Now that we have exchanged greetings perhaps you can tell me what you want."

Actually it turned out to be nothing more than the line sync, which was put right by fitting a new 4·7MΩ base bias resistor (R33) in the sync separator stage on the i.f. unit. He was ready to go and looked round.

"I'd better say goodbye to the wee lassy."

"Oh no you don't" I said, fed up with this hanky-panky. "You just put your set in your car and hop it. All you Scotsmen are the same. Every day is new year's eve."

So off went Jacko and the wife came in through the front door.

Guess Who Popped Back?

"I said cheerio to Mr. Jackson" she said. "But I was speaking to that nice artist fellow who lives up the road. I thought it would be nice if he could paint a picture of Pekey for us."

We have an elderly Pekinese in the family. He's not expected to be with us for much longer, but the thought of retaining an artist to paint the irritable little blighter (he bites me) seemed a little lavish, particularly since we had just paid our income tax, VAT, rates, etc.

"Oh well. We'd better think about that" I demurred.

"Well you'd better think of something, Mrs. Brashley's coming."

Oh no. What a day. What a terrible day. In danced Mrs. Brashley.

"Isn't it incredible? Just too incredible."

"Too incredible" I echoed.

"The sound's gone off. One minute it was there, next minute puff!" So while she related the rest of the day's good news to my honey pot, I once again took the back cover off the hated Pye. Good job it had only four turn keys and not ten thousand screws as on the Dynatron.

The audio output circuit is on the left side i.f. panel, and the supply to it comes via an 18Ω resistor (R249). This is a small wirewound on the upper corner. It was open-circuit through no fault of the BD131 output transistors, a new resistor restoring normal operation.

Ask a Silly Question

"What can we do with this terrible set?" enquired Mr. B.

"Why don't you leave it here and pop up every time you want to see something" I suggested, receiving a kick on the ankle from my lotus blossom.

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ITT, CVC 1 - 5	D.116	5.04	THORN 1590 STICK	D.104	.36
ITT, CVC 20	D.117	5.53	THORN 3000/3500	D.107	5.65
ITT, CVC 30	D.142	5.65	THORN 4000	D.143	5.70
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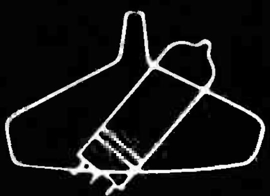

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Long-distance Television

Roger Bunney

THE month of December 1979 was the most spectacular one for long-distance TV reception since I started writing this column in June 1971. Just after the last column was posted, an intense tropospheric opening provided good signals from central and eastern Europe, followed a week later by a shorter but equally intense tropospheric opening on the 6th. The underlying theme through most of December however was the high level of solar activity and the resultant F2 propagation of Band I signals. The averaged sunspot count for October/November 1979 was 187, with peaks of 223 on October 31st and 302 on November 10th. The F2 conditions unfortunately fizzled out towards the end of December – but a surprise and welcome Christmas present was a two hour SpE opening on the morning of Christmas day, with the familiar 0249 test pattern on ch. R1.

Good Tropospheric Conditions

Tropospheric propagation during November 27-29th accompanied a slow moving high-pressure system and gave sustained reception from East and West Germany, Denmark, Poland, Scandinavia and Austria, in Band III and at u.h.f. Reports have come in from many parts of the UK, indicating that reception was widespread (as was the interference to local u.h.f. services). For those in favourable locations, the Band III and u.h.f. spectrums were literally jammed with DX signals.

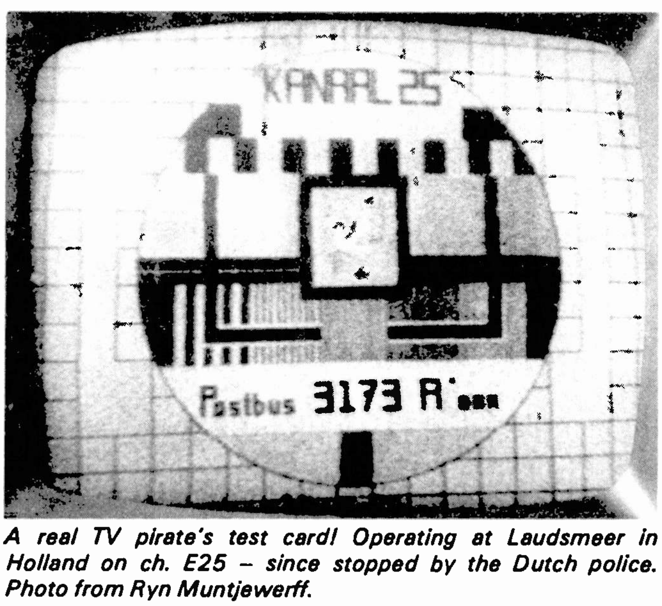
Clive Athowe (near Norwich) received TVP-1 (Poland) ch. R12 Szczecin, several Swiss u.h.f. transmitters, and lots of W. German stations. Hugh Cocks (near Bexhill) received ORF (Austria) ch. E5 and most of the "usual" DDR (East German) u.h.f. outlets. The reception that highlights the intense conditions however was of the BFBS (British Forces Broadcasting Service), by both Hugh and Gareth Price (Lowestoft). It seems that the BFBS leave their West German transmitters on all night, with the PM5544 test pattern. The signals were received during the night of the 28th and during the early morning period of the 29th, and were virtually noise free. Two channels were received, E23 and E48. Unfortunately the EBU has not yet listed the ch. E48 outlet, but the ch. E23 outlet received at Lowestoft was probably Lippstadt. It's the highest powered BFBS outlet on this channel – at 30W!

A repetition of the excellent tropospheric conditions occurred on December 6th (with a slight build up over the 4/5th). French v.h.f./u.h.f. signals predominated here in the south, but elsewhere the reception was of W. German and Scandinavian signals. The most startling logging was David Burton's (Surrey) reception of the Swedish Halmstead ch. E24 transmitter – on a JVC receiver using the set's own indoor array. He had good reception of the programme sign-off followed by the PM5544 test pattern. The distance is some 675 miles, and I feel this must be some sort of record.

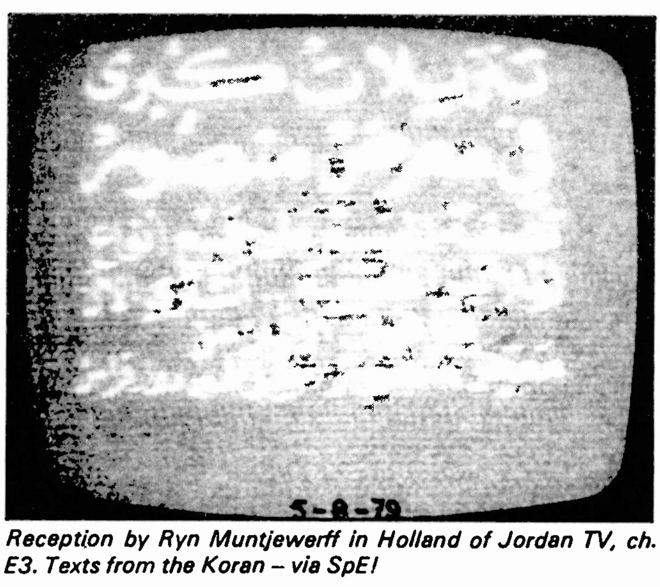
F2 Successes

Undoubtedly however the most important factor has been the sustained F2 propagation – from November until about December 20th. Distant TSS (Russian) signals on ch. R1 have been common, with several transmitters present most days, giving the usual identification problems. I was fortunate on the 12th in noting the test pattern change at 1200 to an identification slide showing a rearing horse with rider, both in black silhouette. This slide is apparently used by the Baku regional station. Ch. R2 (59·25MHz) was received by both Andrew Tett and Chris Wilson on December 17th.

For many enthusiasts the first chances of receiving really strong American ch. A2 TV signals occurred on December 8th. Signals were received from several transmitters, and from the early afternoon the channel was jammed. The ch. A2 signals continued daily for almost ten days, with the usual identification problems. Several definite identifications were made however, with other "probables". The latter are likely to be NBC, while the "definites" occurred on a couple of days when the sound channel (59·75MHz) was also received. Andrew Tett clearly heard a CBC (Canadian Broadcasting Corporation) identification on the 12th at 1300, with a news programme followed by an art programme (though in French). Geoff Chapman



A real TV pirate's test card! Operating at Laudsmeer in Holland on ch. E25 – since stopped by the Dutch police. Photo from Ryn Muntjewerff.



Reception by Ryn Muntjewerff in Holland of Jordan TV, ch. E3. Texts from the Koran – via SpE!

(Blandford, Dorset), using an elderly Bush TV62, heard a ch. A2 station giving the local New Brunswick news, with the weather forecast for the maritime provinces followed by "CBC", on the afternoon of the 15th. This must obviously be CKCW-TV, Moncton, New Brunswick.

The vision quality of these System M signals was fair to poor. There were no problems with locking to the different line/field rates except for reduced height in most cases. My own experience, and that of others, has been of fair vision quality at times during a programme, but poor quality with multiple images as soon as there's any chance of an identifiable caption being present! Numerous commercials have been seen, but generally the presence of several signals at once has made identification impossible.

Australian TV (ch. A0, 46·25MHz vision) was received by Ray Davies (Norwich) for 70 minutes from 0820 GMT on the 8th and by Hugh Cocks from 1020-1030 on the 19th.

My own best day was the 12th. Apart from Canada ch. A2 and the usual Russian signals, including the Baku identification mentioned above, a strong PM5544 test pattern on ch. E2 cleared at 1145, showing an Arabic scrawl across the lower bar. This could only be Dubai.

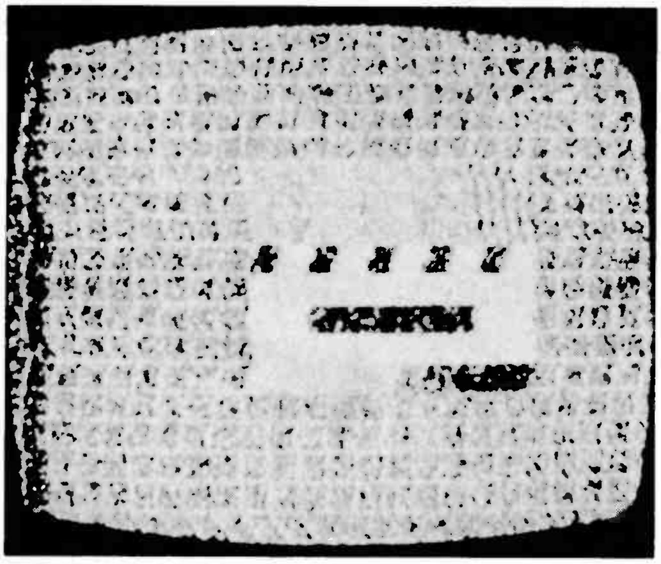
There have been several reports of a mystery Arab station on ch. E3, transmitting the PM5544 pattern and opening with an Arabic script caption (probably the Koran). This is being investigated – I feel that Jordan would be just too near for an F2 signal.

The highest frequencies to be propagated via F2 during December were received on the 14th, when Mike Allmark (Leeds) noted ch. A3 vision (61·25MHz) at 1335, and on the 17th, when Chris Wilson (Potters Bar) observed an F2 signal floating over Lopik ch. E4 (62·25MHz) at 1110.

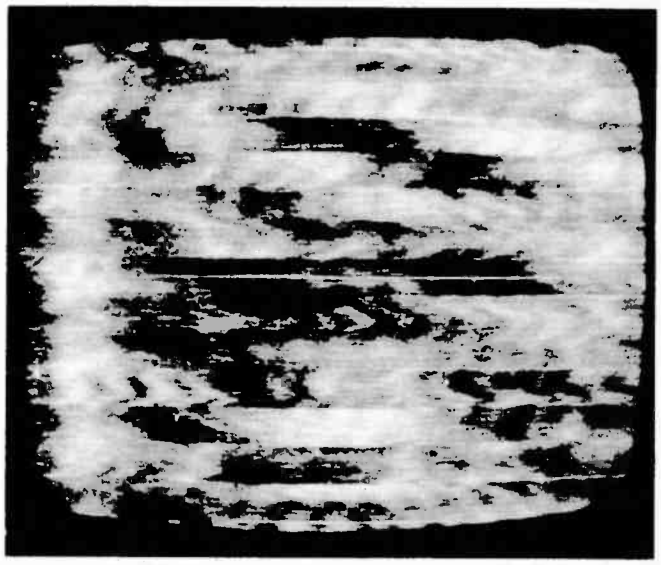
I've left till last the most outstanding reception, by Reg Roper (Torpoint, Cornwall) on December 15th. On previous days he'd logged ch. A2, with snatches of the sound channel. Due to high winds, Reg had lowered his aerials to roof level, but nevertheless continued to receive various F2 signals. Then on the 15th at lunch time ch. A2 lifted above the noise level and the sound channel also became audible. The interesting point however was that the sound was at times in Spanish – the children's programme that could be resolved from time to time matched the sound. As the skip distance subsequently changed, so the programme sources changed to the more usual North American transmitters. The WTFDA transmitter list gives two possibilities for a Spanish language source on ch. A2 (and the programme wasn't a language lesson!). The first and most likely is the WKAQ station at San Juan, Puerto Rico (100kW e.r.p.). The less likely possibility is Cuba. There are three Cuban ch. A2 transmitters, Habana (125kW) being the most likely. All Cuban stations have a 2/1 vision/sound transmission ratio – so TV Nacional

TESTING TRANSISTORS

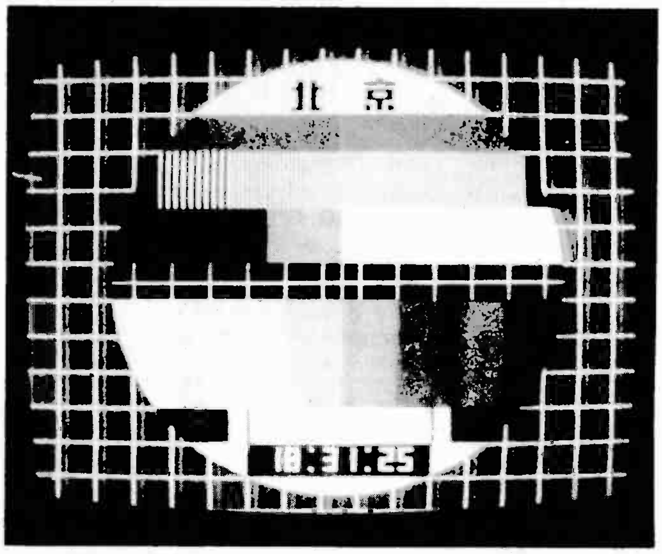
A qualification is required to the information on transistor testing given in the article on servicing portable TV sets in our October 1979 issue (page 652). The details given are correct for most types of transistor. An exception however is transistors such as the AF139 and BF196 which can be operated with forward a.g.c. Lower reverse base-emitter and emitter-collector resistance readings will be obtained with these, the 250:1 ratio not being applicable in this respect. Note also that the readings obtained will vary with the meter range selected. We propose to go into this subject in greater detail in a future article.



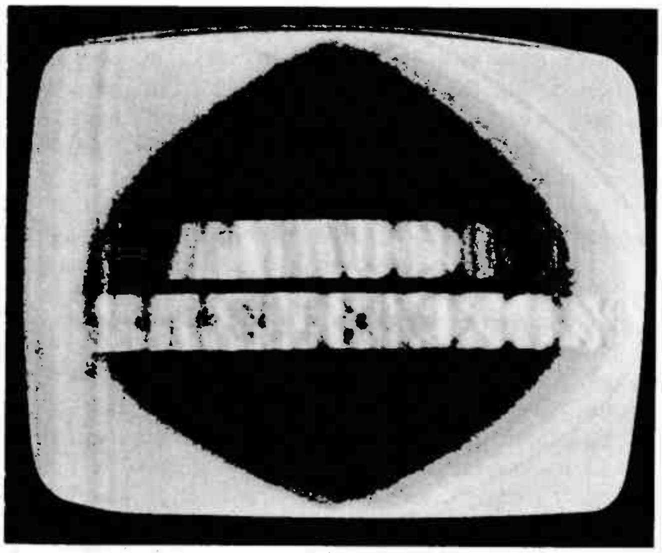
A further photo of Ian Roberts' reception from the Russian Stat-T satellite in South Africa. This time the test pattern, which appears at 1500 S. African time. Frequency 714MHz.



A weak PM5544 test pattern received by Cliff Dykes on October 25th at 1400. The ch. E2 signal could be from Dubai on the Gulf (see last month's column).



The official Chinese test pattern – another version of the PM5544! The identification at the top is Beijing (Peking). Photographed in Peking by John Tellick.



Can anyone give any help in identifying this reception by Petri Pöppönen in Finland on October 21st at 0907 GMT? The F2 signal was on ch. E2 and the words are thought to be "Malibo Television".

Canal 2 Habana has 62·5kW e.r.p. sound. Anyway, our congratulations to Reg on this startling reception, which clearly shows the advantage of monitoring the sound channel.

Apart from a single sighting of the older Indian head test card, the only North American test patterns seen have unfortunately been colour bars with a pulse/bar or frequency gratings beneath.

Band I TV

There have been a lot of rumours lately on the future of Band I TV in the UK. It seems likely that the transmissions will cease during 1985 (assuming the transmitters hold out!), with the relays closing down somewhat earlier. One report suggests that Band I will in future be used for mobile communications and digital sound broadcasting.

From Our Correspondents . . .

John Tellick has just returned from China: a report on TV in the Orient will be included next month, but in view of possible F2 reception we're showing the official Peking test pattern (shot in Peking).

Pindu Padaki (Madras) regularly receives Dubai ch. E2, Aramco (Saudi Arabia) ch. E3, Bahrain ch. E4 and other stations. He's received most Indian stations, including Delhi ch. E4; also Karachi ch. E4 and Bangkok ch. E3. His equipment consists of an Indian manufactured hybrid TV set, wideband Band I array and a preamplifier using two BF200 transistors.

Petri Pöppönen (Lahti, Finland) has received many F2 signals recently including a suspect "Malibo Television" on ch. E2. Has anyone any ideas on this?

Judging by the signals he's received at both v.h.f. and u.h.f., Dave Palmer (Lowestoft) is clearly at a good location. He seems to have received ch. A0 on November 21st at 0905-0920. Alex Clapton, nearby at Ipswich, regularly receives the Dutch first and second network programmes. He comments that a recently received caption suggests that a new relay has opened on ch. E26.

Peter Schubert (Rainham, Essex) had excellent tropospheric reception on November 28/29th, with signals from Belgium, Holland, W. Germany and Denmark received at good strength on his Elizabethen 14in. portable (with up-converter for Band I reception) and a dual-standard Murphy receiver.

Service Bureau

Requests for advice in dealing with servicing problems must be accompanied by a 75p postal order (made out to IPC Magazines Ltd.), the query coupon from page 267 and a stamped addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets nor answer queries over the telephone.

THORN 3000 CHASSIS

Originally the problem was that the cutout would operate about once a week. Now however it won't stay in. There would seem to be an overload but I'm not sure how to proceed.

It could be simply that the cutout itself is defective. They do tend to become unreliable with use. See whether a 2·5A fuse connected in its place holds. If it does, replace the cutout. If it doesn't, disconnect the h.t. fuse F603 on the power supply module. If the fuse/cutout now holds, the chances are that the line output transistor or the h.t. decoupling capacitor C514 (4·7μF) in the line output stage is short-circuit or the tripler faulty. If the fuse/cutout fails with F603 removed, the trouble is in the power supply module. The following are suspect, listed in order of likelihood: the R2010B chopper transistor VT604 short-circuit; one of the mains rectifier diodes W601/2/3/4 short-circuit; the crowbar trip thyristor W621 (BT109A) leaky or short-circuit; the over-voltage sensing zener diode W617 (BZX61/C72) leaky; the power supply "efficiency diode" W616 (Y827 or Y997) faulty; or short-circuit turns on the mains transformer T601.

PHILIPS K70 CHASSIS

The trouble with this set is recurring breakdown of the line shift control R1290. Can you suggest an alternative, since the component is rather expensive and difficult to obtain?

This component is a known source of trouble in the K70 chassis. Its life span will be much increased by adding a 47Ω 1W resistor in parallel with it. It should be possible to use two 7·5Ω potentiometers connected in series as a replacement for R1290.

ITT VC52 CHASSIS

It's impossible to tune in optimum sound with a sharp picture, the worst channel being BBC-1. If the set is tuned for optimum picture clarity there's an annoying irregular buzz on sound – not constant as when a caption is present, but varying like a morse code effect.

The trouble can usually be cured by *very slight* adjustment of the 33·5MHz trap L35 in the coupling circuit between the first and second i.f. amplifier stages. It's the top core of the unscreened coil to the right of V5 (EF183).

PHILIPS 320 CHASSIS

The voltage at TP15 (h.t. test point) is only 120V instead of 163V, hence giving reduced picture size. This voltage cannot be increased by adjusting the set h.t. control R5630. The control transistor T5602 and its associated zener diode D5603 are both in order while if the connection from TP15 to the rest of the set is removed well over 163V can be obtained at TP15. Any ideas as to what's dragging the h.t. voltage down?

Open-circuiting TP15 should result in the safety circuit operating, reducing the h.t to about 90V. The safety circuit concerned consists of diode D5608 (BA154, recommended replacement type BAW62 or BA318) and its series resistor R5635 (3·9kΩ). The fact that this safety action is not taking place should lead to a check of these components. When the safety action has been restored, check for overloading in the line output stage – disconnect feeds from the line output transformer to find out when the h.t. voltage rises to the correct value (which should be set at about 158V for maximum reliability).

GEC COLOUR RECEIVERS

The trouble with one of the single-standard hybrid sets is intermittent operation of the thermal cutout in the line output stage. The fault may not occur for a week, then the cutout will operate three or four times an hour, eventually settling down. The PCF802 line oscillator valve has been replaced. The other set is a solid-state one with hum on sound. Turning up the volume does not increase the hum however. The vision is not affected.

The cutout operates when the line output valve passes excessive current. Intermittent tripping can be caused by trouble in the line oscillator circuit. We suggest you check the resistors to see whether any are charred and replace the polystyrene capacitors (C507, C509 and C512), also the line drive coupling capacitor C511. If the trouble persists, the tripler is suspect. The mains hum on sound with the solid-state set could be due to a noisy mains filter choke. It may help to mount a replacement on a thin strip of rubber or similar material.

THORN 1400 CHASSIS

The picture on all u.h.f. channels is perfect apart from herringbone patterning on the right-hand half of the screen. I'm in an isolated position some five miles from the Sudbury transmitter.

First check the bonding strip from the u.h.f. tuner to the main frame. If it's fitted, try removing it. If there's no improvement, check the bonding on the v.h.f. tuner (which is used as an i.f. amplifier at u.h.f.). Then check the tuning of L209 (v.h.f. tuner) and L1/2/5/6 on the main panel.

GEC 2000 SERIES

We've had the same problem with quite a few of these sets. Every now and again on u.h.f. the picture starts to flutter light and dark – like when an aeroplane passes overhead. The trouble occurs when there's a light scene, and can be cured by turning down the contrast. This gives a very grey picture however.

You will probably find that an improvement is obtained by increasing the value of the a.g.c. filter capacitor C26 from 0·22μF to 0·47μF.

THORN 1500 CHASSIS

I'm having trouble with a field linearity fault on this set – lack of height at the bottom. The PCL805 and its cathode components have been changed and the height circuit checked, but the trouble persists. All voltages in the field timebase seem to be correct.

We suspect the linearity network: check C76 (0·01μF) and the condition of the linearity controls.

THORN 3500 CHASSIS

After about one and half hours the picture gradually starts to darken until eventually there's no picture at all. If the back is then removed, the picture gradually returns. R733 (120Ω) glowed when the fault was present and cooled when the picture returned, so this was replaced using a higher wattage one. The associated 150pF capacitor C770 was also replaced, but the fault persists. If the back is left off and the convergence board is left in the raised position the set will work perfectly for up to six hours.

This fault is not uncommon in the 3500 chassis. It's due to shorting turns on the pincushion distortion correction transductor T751. Be sure to get the correct type. R773 is in series with one of the windings, hence the glow.

BEOVISION 3400

The trouble with this set is intermittent reduction of the red content of the picture, though reasonable colour balance can still be obtained by rotating the tint control fully to the right. The reduction or return of the red content is often preceded by a momentary thin streak of red or green flashing across the screen. Monochrome pictures sometimes have a greenish/yellow cast.

This sort of thing is not uncommon on the 3400, and is usually traceable to the CDA panel on the upper left-hand side. Check for poor seating of the PCL84 output valves, for poor joints on the panel and noisy presets. If these measures fail, suspect leakage in the clamp diodes (3D4/5/7/8/9/10). It's difficult to prove that these are faulty, and we usually replace the lot and then set up the grey scale.

THORN 1500 CHASSIS

The problem is field roll after the set has been on for an hour. I've replaced the sync separator's screen feed resistor R44, but the trouble persists – until the back is removed from the set.

It's often the case that when R44 has deteriorated a strain is placed on R47 (22kΩ), the other resistor in the potential divider network. If the voltage at pin 7 of the 30FL2 is low, check this item. If not, try a new PCL805 field timebase valve and then, if necessary, check the values of R101/R102 (18kΩ) in the oscillator feedback network.

RANK A823B CHASSIS

In this later version of the chassis the flyback pulse balancing network 6R6/6C4 is omitted. Does this affect the procedure for balancing the output transistors?

The current method of balancing the line output transistors in this chassis, approved by the manufacturers, is very simple. Turn the set HT control 8RV1 down by about 30°, and adjust the two balancing coils 6L4/5 for minimum raster width. Then restore the h.t. line to the normal level.

THORN 3000 CHASSIS

The set suddenly went dead, and on examination the mains and the h.t. fuses were both found open-circuit while the line output transistor was short-circuit. The fuses were replaced and a new transistor fitted, but as soon as the h.t. built up the h.t. fuse blew and the new line output transistor went short-circuit. There don't seem to be any other shorts anywhere.

Disconnect the 60V supply line from the receiver circuitry and load it with an ordinary 1kW 240W fire-bar element. This will draw about 1A, and will enable you to confirm that the h.t. line is correct at 60V. If so, disconnect the collector of the line output transistor and check that the line drive waveform is correct (waveform 35 in the manual). If this is o.k., replace the flyback tuning capacitor C521, reconnect the line output transistor and disconnect the tripler. Switch on. If the line output transistor again fails, suspect either the line output or the e.h.t. transformer of having shorting turns (T504 and T503). Another possibility is faulty scan coils – check by disconnecting them. If the transistor survives, fit a new tripler.

GEC C2110 SERIES

When the set is switched on from cold, there's bottom cramping with foldover, also the picture rolls and has to be reset. After two-three minutes the scan opens out and, after resetting the hold control, there's no further trouble.

You'll probably find that the electrolytic capacitor C457 in the field charging circuit is leaky. Check this and if necessary the AC188 driver transistor. If the field hold is still troublesome, replace C452 (4·7μF) which decouples the emitter of the field sync pulse amplifier transistor TR451.

PYE 691 CHASSIS

When the set is switched on there's an immediate buzz on sound. Sometimes the sound is present along with a buzz, while on other occasions there's either no sound or very faint sound. The sound can usually be obtained by pressing the channel change buttons, but the buzz is always present. The set's tuning has been checked and carefully adjusted.

The trouble seems to be instability of the i.f. strip, due to failure of any one of the ceramic decoupling capacitors. Bridge them as a check. Suspect also the i.f. strip l.t. line smoothing electrolytics C42/43, and make sure that the slope detector coil L19 is tuned for optimum sound.

SOBELL 1102

When the brightness is turned up, the picture increases in size. The voltages in the line output stage have been checked and appear to be normal, including the boost voltage, but the e.h.t. is low at 12kV. The line output stage valves, the scan coils and the line output transformer have been checked, but the trouble persists.

The low e.h.t., the cause of the poor regulation, is probably due to the DY802 e.h.t. rectifier not receiving adequate heater voltage. This in turn is likely to be due to the resistive wire element under its base deteriorating so that its value is more than the correct 1·1Ω.

MITSUBISHI CP140B

The picture is usually rather dark, with a red cast in the shadows. The picture may remain in this state for three-four weeks, every time the set is switched on, but on occasions the picture will revert to normal brightness, sometimes for a few hours, never for longer than a week or so.

The set uses RGB drive to the c.r.t Check the cathode voltages (pins 2, 6 and 11) which should be at around 100V give or take a volt or two. Then check the first anode voltages (pins 4, 5 and 13) which should be at around 400V, 600V maximum. If these voltages are low – as they may well be – trace back to socket ME on the main PCB, ensuring good contacts and correct voltage here (600V at pin 1).

GRUNDIG 6010

The following fault has occurred twice during the past two months. On switching the set on, there's no vision or sound on the selected channel, only some pick-up of a foreign radio station (which remains the same on all three channels). The radio pick-up can be varied with the volume control. Normal operation commenced on each occasion after a wait of a few minutes.

It seems that the TBA440 i.c. in the i.f. unit is faulty. Before condemning it however, check for dry-joints on the panel around the chip, and ensure that the "+F" supply is present at module pin 7 and correct at 15V.

TEST CASE

207

Each month we provide an interesting case of television servicing to exercise your ingenuity. These are not trick questions but are based on actual practical faults.

An early yet astonishingly well preserved HMV Model 2700 colour receiver (the Thorn 2000 dual-standard chassis) was brought into the workshop by the field technician with the complaint "picture intermittent, sound o.k." Now although the set is about twelve years old it had obviously been well treated, apparently having lived in the virtually dust-free environment of a large house. In fact it appeared to have been little used, so despite its age it would have been a pity not to give it serious consideration.

According to the field technician the picture was quite unpredictable – on the odd occasion it would appear normally after the warm-up period, though usually it would fail to appear. The field technician had diagnosed e.h.t. trouble, and on checking with an e.h.t. meter this diagnosis proved to be correct.

Thoughts of the somewhat unusual e.h.t. generator arrangement used in the 2000 chassis started to drift back. In fact the stage is rather like a second line output stage, with its own transformer with overwinding (T1), output transistor (VT7), efficiency diode (W3) and flyback tuning capacitor (C9). VT7 is driven by a separate secondary winding on the line driver transformer.

A rather elaborate system is used to provide e.h.t. stabilisation. Briefly, the h.t. supply to T1 and VT7 comes via a series regulator transistor (VT6). The regulator in fact is basically similar to the type of circuit found in monochrome portables. The error detector stage consists of a differential amplifier (VT2/VT3) however, with the base of one of these transistors (VT3) held at a constant voltage by means of a zener diode (W1) while the base of the other transistor senses the voltage at the earthy end of the focus voltage potential divider chain – the focus potential divider chain is in turn connected across the e.h.t. supply. Between the error detector stage and the series regulator transistor are an inverter transistor (VT4) and a driver transistor (VT5). Excess current protection is provided by a zener diode (W2), while a further transistor (VT1) provides protection in the event of the feedback loop going open-circuit (otherwise the e.h.t. would rise to and remain at a maximum level).

The basic idea of all this is that if the e.h.t. tends to fall say, the conduction of the series regulator transistor VT6 is increased, thus increasing the h.t. voltage applied to the e.h.t. generator stage so that the e.h.t. voltage is restored.

A few simple, though not easy to get at; tests suggested that the series regulator transistor VT6 was cut off when the fault was present. As a quick check it was shorted out (collector to emitter), simulating the condition of maximum conduction. This immediately restored the e.h.t.! Clearly then something was preventing VT6 conducting under the fault condition. VT6 was tested and seemed to be in order, but to be on the safe side it was replaced, along with VT4 and VT5. But still no luck: the e.h.t. generator was still lazy, failing to operate most times. The resistors and capacitors in the control circuitry all seemed to measure normally, so it was decided against replacing these.

What do you think was the most likely cause of the trouble? See next month for the answer and for another case in the series.

SOLUTION TO TEST CASE 206
– page 213 last month –

It will be recalled that the first technician investigating the intermittent loss of line sync with a Sobell Model 1040 (GEC single-standard hybrid colour chassis) replaced most of the components in the line oscillator stage and also a number of components in the flywheel sync circuit, including the discriminator diodes.

One component he missed was the only electrolytic in the circuit, C508 (4μF), which decouples the supply to the oscillator circuit. A fault in this capacitor would alter the supply impedance and thus almost certainly change the frequency. This in fact proved to be the case, the line oscillator frequency being perfectly stable after replacing C508, which was found to be going open-circuit intermittently.

It's worth noting therefore that in a stage using a variable reactance (the triode section of the PCF802) a decoupling fault can produce a symptom equivalent to a time-constant alteration.

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TELEVISION MARCH 1980

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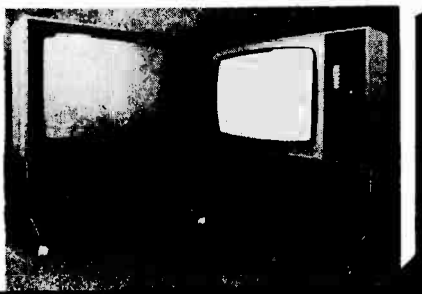

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V2029 V2427
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KB-ITT
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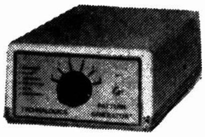

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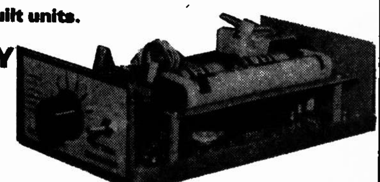

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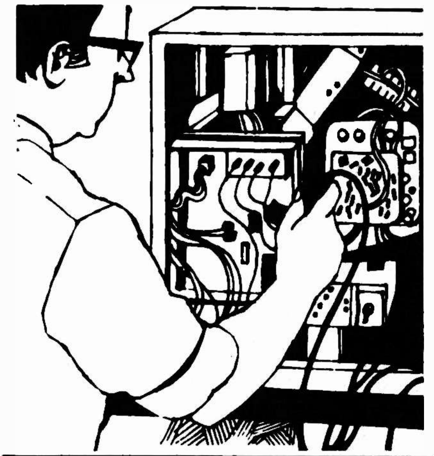

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